NASA
Procedural
Requirements

NPR 8570.1
Effective Date: March 15, 2001
Expiration Date: March 15, 2007

COMPLIANCE IS MANDATORY

Energy Efficiency and Water Conservation w/Change 1 (3/30/04)

Responsible Office: Environmental Management Division

TABLE OF CONTENTS

Change History

NPR 8570.1, Energy Efficiency and Water Conservation w/Change 1 (3/30/04)

Chg#	Code/Center	Approved	Description/Comments
1	O	03/30/04	Deletions of paragraph, references, etc, per Jennings memo dated 12/5/03 and administrative changes made throughout to change NPG to NPR.

Preface

P.1 Purpose

P.1.1 In support and promotion of NASA's Strategic Plan, NASA's Strategy for Environmental Excellence in the Twenty-First Century, and NASA Policy Directive (NPD) 8500.1, "NASA Environmental Management," and consistent with the requirements of the National Energy Conservation Policy Act (NECPA), as amended by the Energy Policy Act of 1992 (EPACT), and Executive Order (EO) 13123, "Greening the Government Through Efficient Energy Management," this directive provides procedural requirements for evaluating and implementing cost-effective energy efficiency, renewable energy, and water conservation measures in NASA facilities and operations.

P.1.2 This NASA Procedural Requirements (NPR) has been prepared to assist NASA Headquarters, Centers, and Component Facilities, Strategic Enterprises, and Institutional Program Offices in implementing the requirements of Federal law, Executive Orders, and NASA policy related to energy efficiency and water conservation.

P.2 Applicability

P.2.1 This NPR applies to NASA Headquarters and NASA Centers, including Component Facilities, and to the Jet Propulsion Laboratory, to the extent specified in its contract.

P.3 Authority

a. 42 U.S.C. 2473(c)(1), Section 203(c)(1) of the National Aeronautics and Space Act of 1958, as amended.

b. 42 U.S.C. 8251, et seq., the National Energy Conservation Policy Act (NECPA), as amended by the Energy Policy Act of 1992 (EPACT) (Public Law 102-486, 106 Stat. 2776).

c. Executive Order 13123, dated June 3, 1999, "Greening the Government Through Efficient Energy Management," 3 CFR (1999 Compilation).

d. Executive Order 13148, dated April 21, 2000, "Greening the Government Through Efficient Energy Management," 3 CFR (2000 Compilation).

e. Executive Order 13149, dated April 21, 2000, "Greening the Government Through Efficient Energy Management," 3 CFR (2000 Compilation).

f. Executive Order 13221, dated July 31, 2001, "Energy Efficiency Standby Power Devices, " 3 CFR (2000 Compilation).

P.4 References

a. 10 CFR Part 434, "Energy Code for New Federal Commercail and Multi-family High Rise Residential Buildings"

b. 10 CFR Part 436, "Federal Energy Management and Planning Programs."

c. 41 CFR Part 101, "Federal Property Management Regulations," Section 101-20.107, "Energy Conservation."

d. NPD 1000.1B, "NASA Strategic Plan."

e. NPR 1000.2, "NASA Strategic Management Handbook."

f. NPR 1000.3, "The NASA Organization."

g. NPD 8500.1, "NASA Environmental Management."

h. NPD 8820.3, "Facility Sustainable Design".

i. NPD 8831.1B, "Management of Facilities Maintenance."

j. NPR 8831.2D, "Facilities Maintenance Management."

k. NASA Environmental Excellence for the Twenty-First Century, dated May 1994 (NASA Administrator's Statement).

l. Office of Management Systems Functional Leadership Plan: Implementing NASA's Strategies for the 21st Century, dated May 1998.

P.5 CANCELLATION

None

/s/ Jeffrey E. Sutton
Assistant Administrator for Institutional and Corporate Management

---

CHAPTER 1. Introduction

1.1 Energy Efficiency and Water Conservation

1.1.1 Conservation is one of the four principal areas of NASA's Environmental Strategy. Conservation is the essence of good stewardship for all the resources NASA controls and reduces the impact of Agency activities on the environment. NASA will strive to improve its energy efficiency and water conservation practices in order to save taxpayer dollars, reduce emissions that contribute to air pollution and global climate change, and conserve precious natural resources for future generations.

1.1.2 In carrying out their assigned energy efficiency and water conservation responsibilities, the following objectives are of special concern to energy managers and facilities maintenance personnel:

a. Minimize energy and water consumption without affecting safety or mission operations.

b. Make personnel aware of the importance of limiting energy and water use to the minimum requirements.

1.1.3 To sustain NASA's state-of-the-art research mission, energy efficiency and water conservation measures must be implemented to --

a. Modernize aging facilities and infrastructure using innovative resources,

b. Maximize funds allocated to NASA Programs and Projects through reduced expenditures for energy and utilities services, and

c. Demonstrate environmental stewardship.

1.1.4 In light of extremely limited appropriations for facility and infrastructure investment, NASA is committed to implementing cost-effective energy efficiency and water conservation measures by utilizing innovative funding sources and initiatives, such as the following:

a. Partnering with other agencies,

b. Utilizing Energy Savings Performance Contracts (ESPC) and Utility Energy-Efficiency Service Contracts (UESC),

c. Increasing employee awareness,

d. Reducing the cost of purchased utilities, and

e. Utilizing alternate fuels and renewable energy technologies.

1.2 Agency Goals

1.2.1 It is NASA's policy to fully comply with the requirements of the NECPA, as amended by the EPACT, EO 13123, "Greening the Government Through Efficient Energy Management," and other statutory and Presidential requirements regarding energy efficiency and water conservation. A summary of pertinent legislation and Executive Orders is included as Appendix A. NASA will strive to reduce energy and water consumption and cost whenever possible in all facility operations. The following goals will be pursued at NASA Headquarters, NASA Centers, Component Facilities, and offsite program facilities:

a. Reduce greenhouse gas emissions attributed to facility energy use by 30 percent by FY 2010, compared to such emission levels in FY 1990.

b. Reduce overall energy use per gross square foot in nonmission variable buildings/facilities 20 percent by FY 2000, 30 percent by FY 2005, and 35 percent by FY 2010, relative to FY 1985 levels.

c. Improve the energy efficiency of energy-intensive buildings/facilities 20 percent by FY 2005 and 25 percent by FY 2010, relative to FY 1990 levels.

d. Improve the energy efficiency of mission variable buildings/facilities 10 percent by FY 2005, relative to FY 1985 levels, and otherwise reduce energy and water waste where cost-effective and without adversely affecting mission performance. This goal does not apply to wind tunnel facilities due to the technical and economic unfeasibility of achieving significant energy efficiency improvement in their design and construction over the required time period and the overwhelming proportion of process-dedicated energy associated with their operation.

e. Expand the use of renewable energy for facilities and operational activities by implementing renewable energy projects and by purchasing electricity from clean, efficient, and renewable energy sources.

f. Reduce the use of petroleum in facility operations by switching to a less greenhouse gas-intensive, nonpetroleum-based energy source where practical and cost-effective and by otherwise improving the efficiency with which petroleum is used.

g. Reduce water consumption and associated energy use by implementing appropriate Best Management Practices (BMP) identified by the Department of Energy (DOE).

h. Conduct energy and water audits for approximately 10 percent of total facilities' gross square footage each year until all facilities have been audited. Audits will be performed independently or through ESPC or UESC.

i. Initiate action to implement all identified energy efficiency and water conservation recommendations with payback periods of less than 10 years by January 1, 2005.

j. Use life-cycle cost analysis in making investment decisions on products, services, construction, and Operations and Maintenance (O&M) practices that significantly affect energy and water usage, so that mission requirements will be satisfied at the lowest life-cycle cost.

k. In accordance with NDP 8820.3, apply sustainable design principles to the siting, design, and construction of new facilities, and where practical, to the rehabilitation and modification of existing facilities, to optimize life-cycle costs, prevent pollution, and minimize energy and water usage throughout their useful life.

l. Where cost-effective over the life cycle, select ENERGY STAR(r) and other energy-efficient products in the upper 25 percent of energy efficiency and products with low standby power requirements as designated by the Environmental Protection Agency (EPA) or DOE.

1.3 Units of Measure and Conversion Factor

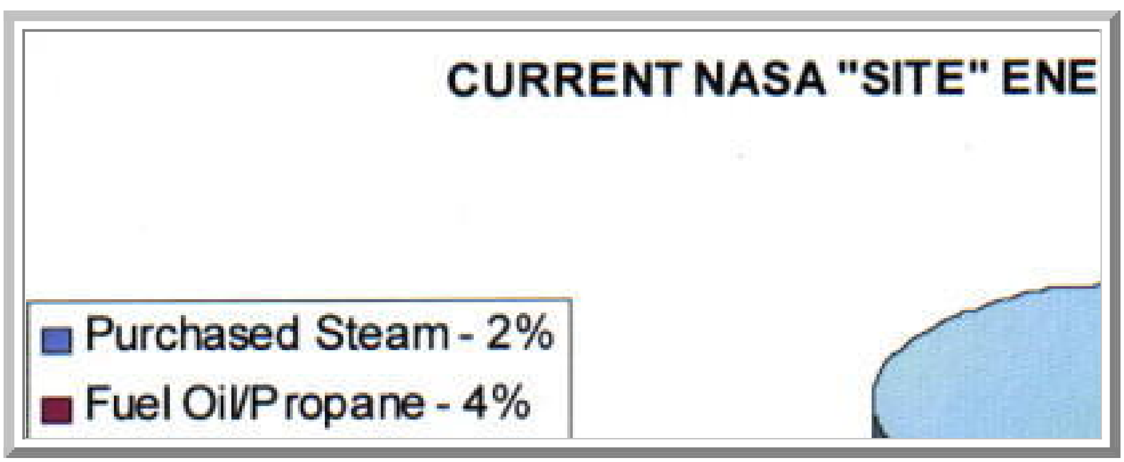
1.3.1 Energy sources typically used in NASA facilities, vehicles, and equipment are defined by common units of energy to provide a means for comparison. Table 1-1 lists these energy and fuel types by the DOE reporting units and their energy content in English and metric units.

Energy or Fuel Type	DOE Reporting Units	British Thermal Units (BTU) per Reporting Unit	Joules per Reporting Unit	GigaJoules (GJ) per Reporting Unit
Buildings/Facilities Excluded Buildings/Industrial				
Electricity	Megawatt Hour (MWH)	3,412,000	3,599,660,000	3.59966
Fuel Oil	1,000 Gallons	138,700,000	146,328,500,000	146.3285

Natural Gas	1,000 Cubic Feet	1,031,000	1,087,705,000	1.087705
Liquefied Petroleum Gas (LPG)/Propane	1,000 Gallons	95,500,000	100,752,500,000	100.7525
Coal	Short Ton	24,580,000	25,931,900,000	25.9319
Purchased Steam	Billion British Thermal Units (BBTU)	1,000,000,000	1,055,000,000,000	1,055.0
Other	BBTU	1,000,000,000	1,055,000,000,000	1,055.0

Vehicles/Equipment

Auto Gas	1,000 Gallons	125,000,000	131,875,000,000	131.875
Diesel	1,000 Gallons	138,700,000	146,328,500,000	146.3285
LPG/Propane	1,000 Gallons	95,500,000	100,752,500,000	100.7525
Aviation Gas	1,000 Gallons	125,000,000	131,875,000,000	131.875
Jet Fuel	1,000 Gallons	130,000,000	137,150,000,000	137.150
Navy Special	1,000 Gallons	138,700,000	146,328,500,000	146.3285
Other	BBTU	1,000,000,000	1,055,000,000,000	1,055.0



1.3.23 NASA Headquarters uses the standard energy conversion factors shown in Table 1-1 in reporting Agency energy use to DOE. When the actual energy content of fuels and purchased nonelectric utilities used by the Center deviates from these standards, Centers may adjust the energy consumption units reported to Headquarters to account for this difference using the formula: Reported Consumption Units equals Actual Consumption Units multiplied by

DOE Energy Conversion Factor divided by Actual Energy Conversion Factor.

1.4 Center and Component Facility Responsibilities

1.4.1 Centers and Component Facilities are responsible for achieving the Agency energy efficiency and water conservation goals specified in paragraph 1.2 at the local level. In addition, each Center and Component Facility shall accomplish the following:

a. Appoint an energy manager for the Center or Component Facility to serve as the focal point for all energy matters and to manage and monitor energy consumption and conservation.

b. Perform energy surveys and identify, request funds for, and implement energy-efficiency and water conservation measures that are cost-effective over the life cycle.

c. Determine appropriate facility designations for energy reporting purposes and justify each mission variable building/facility exemption claimed.

d. Survey petroleum-consuming facilities to identify opportunities to switch to a less greenhouse gas-intensive, nonpetroleum-based energy source where practical and cost-effective.

e. Investigate the technical and economic viability of entering into ESPC's and UESC's.

f. Ensure that new facilities are designed and constructed to comply with the Federal energy performance standards set forth in 10 CFR 434 Energy Code for New Federal Commercial and Multi-Family High Rise Residential Buildings.

g. Implement an awareness program to reduce waste in onsite energy and water use by Federal and contractor employees.

h. Submit required energy efficiency and conservation management information to Headquarters. Reporting requirements are identified in chapter 2.

i. Prepare a 5-year Energy Efficiency and Water Conservation Plan and update on a maximum 3-year interval. Requirements for preparing Center Plans is provided in chapter 3.

CHAPTER 2. Reporting Metrics

2.1 Energy-Consuming Facilities Definitions

2.1.1 The following standard NASA terms apply to energy-consuming facilities for the purpose of reporting and measuring progress toward energy-efficiency goals.

2.1.1.1 Nonmission Variable Buildings/Facilities: Standard buildings or facilities that are subject to the energy-efficiency improvement goals for Federal buildings set forth in EO 13123, Section 202. This category includes office buildings, storage buildings, laboratories, and other research and development buildings that are not energy-intensive. It does not necessarily include industrial and laboratory facilities housing energy-intensive activities, or mission variable facilities for which NASA claims exemption from Federal energy-efficiency improvement goals. However, Centers and Component Facilities may designate energy-intensive facilities as nonmission variable at their discretion.

2.1.1.2 Energy-Intensive Buildings/Facilities: Buildings or facilities that are subject to the energy-efficiency improvement goals for industrial and laboratory facilities set forth in EO 13123, Section 203. This definition includes laboratories, research facilities, electronics-intensive facilities, and facilities housing 24-hour-a-day operations that consume energy far in excess of the normal heating, cooling, lighting, ventilation, and water-heating energy load requirements of a standard building or facility of comparable size. This category includes the following:

a. Industrial Facilities: Any fixed equipment, building, or complex for production, manufacturing, or other processes that uses large amounts of capital equipment in connection with, or as part of, any process or system, and within which the majority of energy use is not devoted to the heating, cooling, lighting, ventilation, or water-heating energy load requirements of the facility. Examples of industrial facilities are as follows:

(1) Manufacturing Facilities: Manufacturing facilities use large amounts of industrial equipment in a well-defined process to produce multiple units of individual finished products from raw materials and prepurchased subassemblies as required to support the missions of the individual NASA Strategic Enterprises.

(2) Refurbishment and Coating Facilities: Refurbishment and coating facilities repair or restore the original condition of multiple units of individual products as required to support the missions of the individual NASA Strategic Enterprises. This includes the replacement of worn/damaged components and the preparation required for the application of a coating system such as sandblasting and cleaning.

b. Operational, Test, and Support Facilities: Facilities that provide direct technical support to the design, development, test and evaluation, and regular mission operation activities for one or more of NASA Strategic Enterprises. These are facilities that may have special temperature, humidity, critical air control, data collection, or power requirements. Such facilities include, but are not limited to the following:

(1) Engine research and test stands.

(2) Space communication buildings and tracking stations.

(3) Data processing and interpretation facilities.

(4) Laboratories.

(5) Centrifuges.

(6) Environmental simulation and test facilities.

(7) Launch preparation, launch, and landing facilities.

(8) Flight/motion and mission simulation facilities.

c. Cleanrooms: Facilities utilized in a manner as to provide critical temperature, humidity, and air quality control in a dust-free environment. A cleanroom facility should, as a minimum, occupy 50 percent or greater of the facility's volume and shall be Class 100,000 or less. The facility provides the environment required for research, testing, integration, or assembly of flight hardware or experimentation in support of Strategic Enterprises.

d. Utility Distribution Facilities: Facilities that provide and distribute chilled water, hot water, steam, electricity, or any other form of utility service for the purpose of sustaining the mission activities of multiple facilities.

2.1.1.3 Mission Variable Buildings/Facilities: Energy-intensive buildings or facilities for which NASA claims exemption from the energy-efficiency improvement goals for standard buildings and industrial and laboratory facilities set forth in EO 13123, Sections 202 and 203. Exemptions must be justified on the basis of technical or economic infeasibility of making significant energy efficiency improvements due to the facility's physical nature or where conventional performance measures are rendered meaningless by an overwhelming proportion of process-dedicated energy. This category includes the following:

a. Wind Tunnel/Model Development Facility: Aerodynamic and aeropropulsion research and development facilities that provide low and/or high speed conditioned gas flow for performance, controls, and other aerospace testing of components and models.

b. Goldstone Deep Space Communications Complex: One of the three Deep Space Network communication complexes worldwide which support NASA's planetary and interplanetary missions. This category includes all energy-consuming facilities at the Goldstone complex.

c. Operational, Test, and Support Facilities, Cleanrooms, and other energy-intensive facilities that meet the following criteria:

(1) Contain equipment, processes, or systems used in scientific research, development, test, and evaluation in direct support of one or more of NASA's Strategic Enterprises.

(2) Energy costs are funded by benefiting program(s) (except where all facility energy costs are paid by the institution from a single appropriation).

(3) Annual energy usage equals or exceeds the minimum British Thermal Units (BTU) per gross square foot per year (BTU/GSF/Year) values shown in Table 2-1 for facilities classified as "Buildings"; or 5 billion BTU's for facilities classified as "Other Structures".

Center/Component Facility/Location	Minimum BTU/GSF/Year
Glenn Research Center	375,000
Plum Brook Station	375,000
Goddard Space Flight Center	350,000
Langley Research Center	325,000
Wallops Flight Facility	325,000
Dryden Flight Research Center	300,000
Marshall Space Flight Center	300,000
Tracking Stations	300,000
White Sands Test Facility	300,000
Ames Research Center	275,000
Johnson Space Center	275,000
Michoud Assembly Facility	275,000
Stennis Space Center	275,000
KSC Vandenberg Launch Site	275,000

Jet Propulsion Laboratory	250,000
Kennedy Space Center	250,000
NASA Industrial Plants at Downey & Palmdale	250,000
Santa Susana Field Laboratory	250,000

Note: (1) Minimum BTU/GSF/Year values for mission variable buildings/facilities are based on a minimum energy intensity of 150,000 BTU/SF/Year for process energy and 100,000 BTU/GSF/Year for building energy. Of the building energy portion, 55 percent is considered weather dependent (e.g., energy used for heating, cooling, and ventilating), and 45 percent is considered fixed (e.g., energy used for lighting, hot water heating, and miscellaneous loads). The weather-dependent portion of the minimum energy intensity was adjusted to account for differences in weather conditions (average heating and cooling degree days) at NASA Centers and Component Facilities.

Table 2-1. Minimum BTU/GSF/Year for Mission Variable Buildings/Facilities

2.2 Reporting Requirements

2.2.1 Each Center and Component Facility is required to submit the following energy-efficiency and conservation management information to Headquarters for production of Energy Management budget exhibits for DOE and the Office of Management and Budget (OMB), the annual Agency energy report to the President and Congress, and to evaluate progress toward the Agency energy-efficiency goals:

a. Annual budget projections for energy, purchased utilities, and energy efficiency and water conservation activities.

b. Quarterly energy consumption data within 60 days of the close of the fiscal quarter.

c. Annual updates to energy-consuming facility classifications, exempt facility justifications, metrics data, water usage, and related information on energy efficiency and water conservation accomplishments.

2.2.2 Center and Component Facility energy managers will report this information through the Agencywide automated NASA Environmental Tracking System (NETS).

2.3 Metrics

2.3.1 An energy metric is a mathematical equation used to track energy use against productive output, facility utilization, or physical characteristics to measure progress toward Agency energy-efficiency goals. The following metrics shall be used to evaluate progress for each facility energy goal category and for individual facility types.

2.3.1.1 Nonmission Variable Buildings/Facilities: Agencywide, Center, and Component facility progress toward the energy-efficiency goal for nonmission variable buildings/facilities will be calculated using BTU's per Gross Square Foot per Year (BTU/GSF/Year) as the metric.

2.3.1.2 Energy-Intensive Buildings/Facilities: Agencywide progress toward the energy-efficiency goal for energy-intensive buildings/facilities will be calculated using BTU/GSF/Year as the metric. Center and Component Facility progress will be calculated using the following metrics for specific facility types:

a. Industrial Facilities (includes Manufacturing and Refurbishment and Coating Facilities): BTU Input/Number of Units Produced or Processed/Degree Day measures the amount of energy used per product/goods produced or processed. The number of degree days compensates for extreme hot/cold weather operation and may be assumed as "1" if not desired to be utilized.

b. Operational, Test, and Support Facilities: BTU/GSF/Year including all significant energy sources.

c. Cleanroom Facilities: BTU/Gross Cubic Feet/Year. The metric should include all significant energy sources. Research-specific loads are not considered significant compared to support loads (building, heating, ventilating, air-conditioning, and personnel).

d. Utility Distribution Facilities: BTU Output/BTU Input measures the efficiency of energy conversion for the production of hot/chilled water, steam, electricity, and high pressure air. BTU input will be for natural gas, kilowatts, and fuel oil. BTU output will be in chilled/hot water, steam, and kilowatts. The metric should use source data from utility system O&M logs.

2.3.1.3 Mission Variable Buildings/Facilities: Agencywide, Center and Component Facility progress toward the energy-efficiency goal for mission variable buildings/facilities will be calculated using the following metrics for specific facility types:

a. Goldstone Deep Space Communications Complex: Million of BTU's (MBTU) per Tracking Hour measures the amount of energy consumed by space communication systems and support equipment per mission tracking hour. The metric should include all significant energy sources and use source data from facility operations logs.

CHAPTER 3. Energy Efficiency and Conservation Management Program

3.1 The Energy Efficiency and Conservation Management Program

3.1.1 Energy efficiency and conservation management ensure that energy and water are used effectively and judiciously. A successful program not only involves energy conservation and engineering, but every area of institutional management, including facilities and maintenance management, procurement, administration, and communications and public affairs.

3.1.2 There are many ways to increase energy efficiency, although nearly all measures can be classified into the following basic categories that make up the foundation of the energy management program:

a. Low- and no-cost O&M measures to ensure peak performance from new existing energy-consuming systems.

b. Retrofit to provide technological improvements to existing buildings and equipment.

c. Replacement of worn out equipment with high-efficiency equipment (although inefficient equipment should be replaced prior to its scheduled replacement time if economically beneficial).

d. Installation of energy-efficient equipment, systems, and components in new construction and major rehabilitation and modification projects.

e. Load shifting and peak shaving to reduce utility demand charges.

3.1.3 To be successful, an energy efficiency and conservation management program must be carefully planned, following a logical sequence of steps, as follows:

a. Obtain top management support for an effective energy conservation program.

b. Organize the Energy Efficiency Team (EET).

c. Gather background information by evaluating energy purchases, establishing an Energy Use Index (EUI), and assembling other data to identify energy consumption patterns and potential areas for energy conservation opportunities.

d. Conduct an energy audit to identify and prioritize energy conservation opportunities. Conducted either by qualified in-house engineers or by contractors, this can be a walk-through or comprehensive audit. The energy audit is addressed in depth in chapter 4.

e. Develop the Center Energy-Efficiency and Water Conservation 5-Year Plan by establishing priorities and formulating schedules, budgets, and goals. The Plan should be a formal written document, outlining the Center's energy policy and objectives, strategies, programs, and action items making up the strategic plan to realize the energy policy's goals. Recommended elements of the Plan are detailed in paragraph 3.2.

f. Implement, promote, and monitor the plan. This includes energy project budgeting and programming, energy management program reporting, and energy awareness program development.

3.2 Center Energy-Efficiency and Water Conservation 5-Year Plan

3.2.1 Requirement. EO 13123, Section 302, requires NASA to prepare an annual implementation plan for fulfilling the requirements of the Order. The Agency implementation plan is based on individual plans developed by each Center and Component Facility. Each Center and Component Facility is required to develop and maintain an individual Energy-Efficiency and Water Conservation 5-Year Plan tailored to the needs, resources, and opportunities at each

location.

3.2.2 Preparation and Submission. Each Center shall maintain an Energy Efficiency and Water Conservation 5-Year Plan approved by the Center Director. Component Facility plans may be included as part of the Center plan, or if approved by the Center Director, prepared separately. Approved Center Plans must be submitted to the Associate Administrator for Management Systems, with a copy to the cognizant Enterprise Institutional Program Officer within one year of the date of this directive. Center plans shall be reviewed and updated as needed, but not less than every three years. The Director, Environmental Management Division, Headquarters Code JE, shall review Center plans to ensure that they are current during Energy and Water Management Functional Reviews.

3.2.3 Content. Center plans shall focus on goals, implementation strategy, and resource requirements. The plans are intended to elicit and sustain management support. Center plans shall include the following elements:

a. Mission/Value Statement - A simple statement of why the plan is important and what it will accomplish in 5 years.

b. Authorities - Identify applicable Federal statutes, Executive Orders, Agency and Center directives related to energy and water management such as:

c. Goals - Describe the long-term goals of the plan, what is required to meet them, and the expected outcomes if the goals are met.

(1) The following long-term goals shall be included in the plan as applicable to the Center:

(i) Reduce energy use per gross square foot in Nonmission Variable Buildings 20 percent by FY 2000, 30 percent by FY 2005, and 35 percent by FY 2010, relative to FY 1985 baseline.

(ii) Improve energy efficiency of Energy-Intensive Buildings 20 percent by FY 2005 and 25 percent by FY 2010, relative to FY 1990 baseline.

(iii) Improve energy efficiency of Mission Variable Facilities 10 percent by FY 2005, relative to FY 1985 baseline.

(iv) Reduce greenhouse gas emissions attributed to facility energy use 30 percent by FY 2010, relative to FY 1990 baseline.

(v) Expand renewable energy use.

(vi) Reduce petroleum use.

(vii) Reduce water use by implementing appropriate best management practices.

(viii) Reduce utility costs.

(2) Current progress - Review current Center progress toward these goals.

(3) Required actions - Identify additional actions needed to meet the long-term goals.

(4) Expected outcomes - Identify the tangible and intangible benefits of taking these actions including all associated savings and cost avoidances.

d. Organization - Describe the Center organization for energy efficiency and conservation management, including authorities and responsibilities.

(1) Lead and supporting organizations.

(2) The EET.

(3) Ad hoc "Tiger" teams.

e. Audits - Identify facility audits completed since 1991. Identify required facility audits to be performed over the next 5 years and how will they be accomplished.

f. Projects - Identify significant energy efficiency, renewable energy, and water conservation projects that will be implemented over the next 5 years and how will they be funded.

(1) Construction of Facilities (CoF) funded.

(2) Center funded.

(3) Alternative financing.

(i) ESPC.

(ii) UESC.

g. Resources - Identify resources needed to implement the plan.

(1) Funding.

(2) People.

(3) Training.

h. O&M - Identify O&M procedures or process improvements that will be implemented or sustained over the next 5 years to help manage energy and water use.

i. Awareness - Identify energy efficiency and water conservation awareness activities that will be implemented or sustained over the next 5 years.

(1) Communication with employees, contractors, and the general public.

(2) Ongoing outreach programs.

(3) Specific activities and events.

3.3 The Energy Manager

3.3.1 As required by NPD 8500.1, "NASA Environmental Management," a key individual shall be appointed at each Center and Component Facility to serve as the focal point for all energy matters and to manage and monitor energy consumption and conservation. These individuals shall become trained energy managers as required by EPACT.

3.3.2 EPACT requires executive departments and agencies to establish and maintain programs to ensure that facility energy managers are "trained energy managers." This entails demonstrated proficiency or a completed course of study in all of the following areas:

a. Fundamentals of building energy systems.

b. Building energy codes and applicable professional standards.

c. Energy accounting and analysis.

d. Life-cycle cost methodology.

e. Fuel supply and pricing.

f. Instrumentation for energy surveys and audits.

3.3.3 Demonstrated proficiency can be verified by on-the-job performance in current or previous positions or through certification as an energy manager by an appropriate professional organization or public education institution. Alternative courses of study must have been obtained through a private or public education institution, a Government agency program, or a professional association training program.

3.3.4 Responsibilities. The energy manager serves as the local source of expertise on energy conservation and efficiency management policies, procedures, requirements, and processes. In addition to the responsibilities assigned in NPD 8500.1, the energy manager shall perform or manage the specific activities delineated below and summarized in Figure 3-1.

a. Planning and Organization

(1) Prepare and update the Center Energy-Efficiency and Water Conservation 5-Year Plan.

(2) Review and monitor energy-use trends, patterns, and future requirements.

(3) Track progress toward meeting agency energy goals.

(4) Monitor monthly utility bills.

(5) Organize a Center EET.

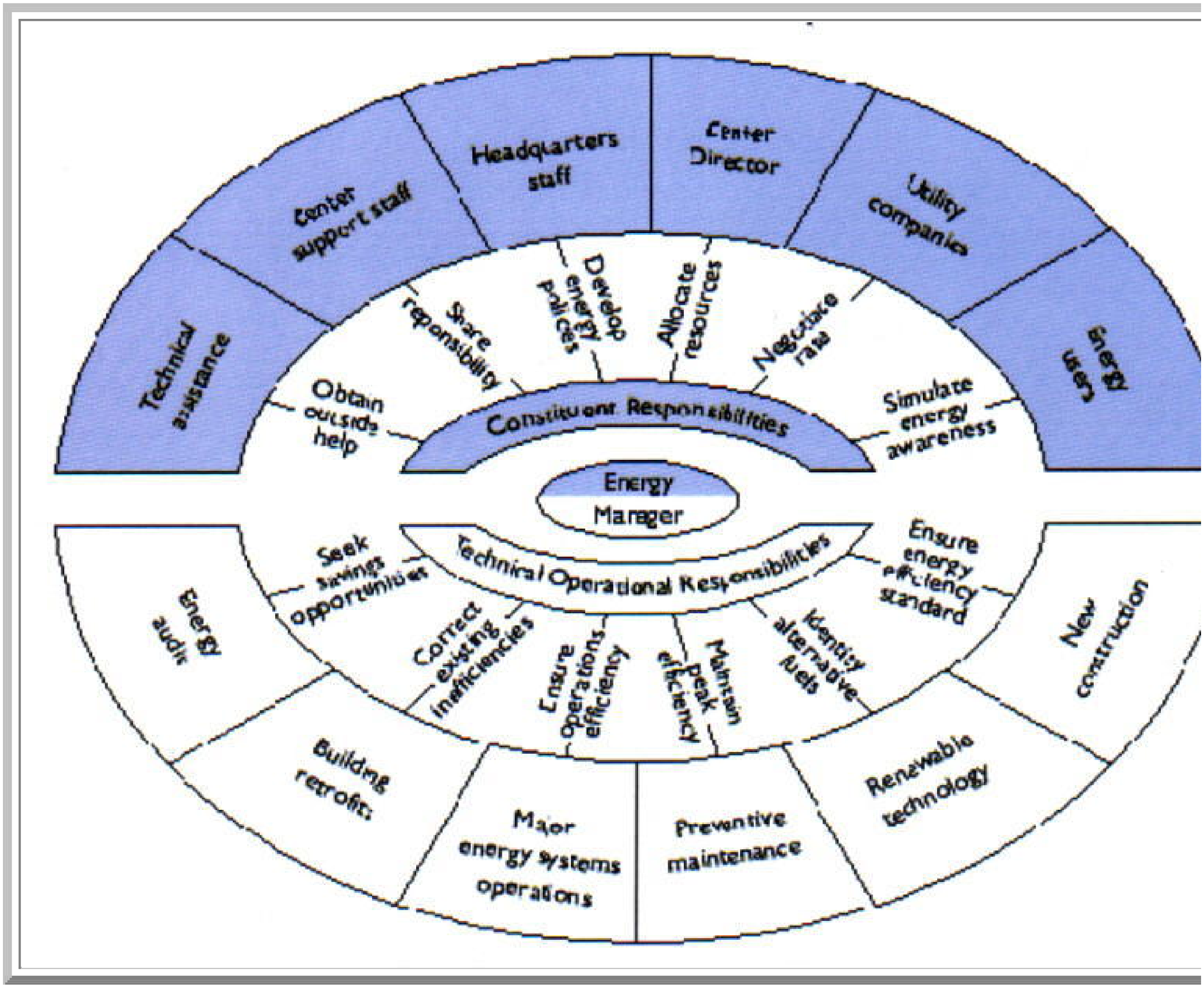


Figure 3-1. Responsibilities of the Energy Manager

b. Budgeting and Project Programming

(1) Assist in preparing the Center energy budget.

(2) Request funds for energy projects.

(3) Keep track of energy project funding status.

c. Program Management

(1) Establish and promote an energy awareness program among Federal and contractor personnel.

(2) Initiate and manage an energy audit program using approved life-cycle cost methods.

(3) Establish and implement certification procedures to ensure that new facilities are designed and constructed to comply with existing Federal energy performance standards.

(4) Monitor CoF and Center-funded energy projects.

(5) Provide technical input to facilities maintenance programs to ensure that energy efficiency is addressed in facilities maintenance programs.

(6) Initiate a facilities metering program.

(7) Participate in demand-side management (DSM) programs.

(8) Investigate ESPC and UESC opportunities and take the lead in implementing such contracts.

(9) Procure energy-efficient supplies and equipment replacements.

(10) Prepare an emergency conservation plan. The requirement for emergency conservation plans is contained in 10 CFR 436, Subpart F, Section 436.105. Appendix D provides a recommended plan of action for emergency electricity reduction at Federal developed by DOE. Center emergency conservation plans shall be customized to site-specific conditions.

d. Administration

(1) Determine and maintain appropriate nonmission variable, energy-intensive, and mission variable facility energy designations.

(2) Report quarterly energy consumption data to Headquarters via NETS.

(3) Report annual energy program accomplishments to Headquarters via NETS.

(4) Establish and communicate Center energy policies.

(5) Coordinate EET activities.

(6) Review and evaluate energy suggestions.

(7) Establish an energy award program.

(8) Participate in utilities contract negotiations.

3.3.5 Although facility construction is beyond the scope of this NPR, energy managers shall participate in design reviews to ensure that designers are meeting the energy design requirements outlined in 10 CFR Part 434 and the sustainable design and construction requirements of EO 13123 and NPD 8820.3.

3.4 The Energy Efficiency Team

3.4.1 After obtaining top management support each Center shall establish an EET. The EET plans and implements all activities of the energy efficiency and conservation management program. Spreading responsibilities among various organizations helps establish program identity and gives those organizations a stake and interest in program decisions.

3.4.2 The selection of the energy manager is the first and most important step in building an EET. The energy manager is responsible for leading and managing all energy efficiency and conservation management program activities carried out by the EET. The energy manager must be a dynamic individual who takes the initiative to develop forward-thinking energy efficiency and conservation management approaches and accomplish action items.

3.4.3 The EET shall be drawn from a wide cross-section of relevant Center organizations, including: Center Operations, Transportation, Chief Financial Officer, Logistics, Procurement, Public Affairs, and the Program and Project organizations (such as Research Directorates). Onsite support contractors responsible for O&M of energy-consuming systems and equipment shall be included on the team as appropriate. The primary qualifications for participation should be willingness and enthusiasm. Team members not only must be dedicated to the concept of energy efficiency and conservation management, but also should be in a position that enables them to implement the program within their own organization.

3.4.4 In addition to involving the various organizations in the energy efficiency and conservation management program through the EET, the energy manager must establish informal lines of communication with key staff members whose assistance is critical in implementing energy efficiency and conservation management projects. These staff members include building managers from each facility, utilities managers, plant supervisors, contracting officers, design engineers, supply officers, project programmers, budget managers, other energy managers, and utilities company representatives.

CHAPTER 4. Energy Auditing

4.1 The Energy Audit

4.1.1 The purpose of the energy audit is to identify energy-efficiency and cost-savings opportunities among building systems and equipment. The goal of the energy audit is to identify life-cycle, cost-effective energy conservation measures by evaluating the overall efficiency of building systems (HVAC, lighting, envelope) and the efficiency of individual components comprising those systems (pumps and motors, lamps and ballasts, windows). Energy audits shall be performed to the level of detail needed to identify, analyze, and document potential energy conservation measures. Although NASA facilities have been improved over the years by retrofits, many buildings, both old and new, still offer great energy- and cost-saving opportunities.

4.1.2 EO 13123 requires NASA to conduct or obtain comprehensive facility audits for all of its nonmission variable and energy-intensive facilities and to ensure that audits are completed for approximately 10 percent of these facilities each year. NASA shall also perform at least a walk-through level energy audit for all mission variable facilities over the same 10-year period.

4.2 Types of Audits

4.2.1 Walk-Through Energy Audits. A walk-through energy audit is a visual inspection of a facility made to determine operation and maintenance energy saving opportunities, as well as gather information to determine the need for a more detailed audit. The walk-through audit shall be arranged so that the audit team can see the major operational and equipment features of the facility. A walk-through audit usually begins with a review of a building's energy consumption over a prior period, usually the previous year. It is best for this information to be prepared in the form of an EUI, discussed in chapter 3.

4.2.1.1 Two types of information shall be recorded. First, identify and record what equipment and systems are installed, how the various equipment and systems interoperate and consume energy. Second, determine and record the evident conditions of the installed equipment and systems and, as appropriate, the energy conservation opportunities suggested by virtue of these existing conditions.

4.2.1.2 Walk-through energy audits are designed to identify only those deficiencies that are most obvious. Most substantial energy savings will be identified only through the more rigorous investigation of the comprehensive energy audit. Accordingly, walk-through audits are only appropriate for facilities under 10,000 gross square feet, for exempt facilities for which comprehensive audits would be too complex or costly, and as a means to prioritize facilities for conducting comprehensive audits. Typical concerns which may be covered by a walk-through audit include reduction of infiltration/exfiltration; quality of HVAC equipment O&M, including controls; lighting system energy efficiency opportunities; ventilation system operation, control, and opportunities for improvement; and tenant use practices.

4.2.2 Comprehensive Energy Audits. A comprehensive facility audit is defined as a survey of a building or facility that provides sufficiently detailed information to allow an agency to enter into energy or water-savings performance contracts or to invite inspection and bids by private upgrade specialists for direct agency-funded energy or water efficiency investments. The comprehensive facility audit shall include information such as the following:

a. The type, size, energy use, and performance of the major energy using systems and their interaction with the building envelope, the climate and weather influences, usage patterns, and related environmental concerns.

b. Appropriate energy and water conservation maintenance and operating procedures.

c. Recommendations for the acquisition and installation of energy conservation measures, including solar and other renewable energy and water conservation measures.

d. A strategy to implement the recommendations.

4.3 Reserved.

4.3.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

f. Reserved.

g. Reserved.

4.4 Reserved.

4.4.1 Reserved.

4.4.2 Reserved.

4.4.3 Reserved.

4.4.4 Reserved.

4.5 Reserved.

4.5.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

4.5.2 Reserved.

4.5.3 Reserved.

4.6 Reserved.

4.6.1 Reserved.

4.6.2 Reserved.

4.6.3 Reserved.

4.6.4 Reserved.

4.7 Reserved.

4.7.1 Reserved.

4.7.1.1 Reserved.

4.7.1.2 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

4.7.1.3 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

4.7.1.4 Reserved.

4.7.1.5 Reserved.

4.7.1.6 Reserved.

4.8 Reserved.

4.8.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

f. Reserved.

g. Reserved.

h. Reserved.

i. Reserved.

j. Reserved.

k. Reserved.

l. Reserved.

4.8.2 Reserved.

4.8.2.1 Reserved.

4.8.2.2 Reserved.

4.9 Life-Cycle Costing

4.9.1 Life-cycle cost analysis is an integral part of the energy audit. Life-cycle cost analysis takes into account initial cost of the energy savings upgrade, energy costs and savings, operation and maintenance costs, component replacement costs, salvage value, and other factors that will affect cost over the entire life of the project. This will provide the necessary information to make a final decision on implementation of an energy savings measure.

4.9.2 To determine energy and demand savings, compare the energy and demand usage of the existing system with the roposed energy savings upgrade. Then perform a financial analysis that compares the cost of maintaining the existing system and the energy costs associated with the existing system to the cost of upgrading and maintaining the new system and the energy costs associated with the new system. The life-cycle cost analysis determines the net present value, savings to investment ratio, and internal rate of return of the investment. Typical acceptable life-cycle cost values are savings to investment ratio greater than one and an internal rate of return greater than 20 percent.

4.9.3 The Life-Cycle Costing (LCC) methods and procedures delineated in 10 CFR Part 436, Subpart A, must be followed, unless specifically exempted, in evaluating the cost-effectiveness of potential energy conservation and renewable energy investments in Federally-owned and leased buildings. LCC is the primary tool for analyzing energy retrofit projects. It considers all relevant costs. The data can be combined in the following ways to evaluate economic performance:

a. Total Life-Cycle Cost (TLCC). TLCC is the sum of all dollar costs of owning, operating, and maintaining a building or building system over the study period discounted to present value.

b. Net Life-Cycle Savings. This parameter is the decrease in TLCC cost attributable to an energy conservation project.

c. Savings-to-Investment (SIR) Ratio. The SIR is a numerical ratio comparing the projected reduction in energy costs (net of increased nonfuel operation and maintenance costs) to the estimated increase in investment cost, minus increased salvage values.

d. Simple Payback (SPB). The SPB is the elapsed time between the initial investment and the time at which cumulative savings in energy costs, net of other future costs, are just sufficient to offset the initial investment cost.

4.9.3.1 Each parameter has a different application. For example, the TLCC is best for choosing among alternative designs for a new building, whereas the SIR is best for ranking retrofit projects.

4.9.3.2 The National Institute of Standards and Technology (NIST) assists DOE in developing LCC methods and procedures. NIST Handbook 135, "Life-Cycle Costing Manual for the Federal Energy Management Program," is a valuable guide to understanding and applying LCC and related methods of economic analysis. Another NIST publication, "Energy Prices and Discount Factors for Life-Cycle Cost Analysis," provides an annual update of energy price and discount factor multipliers needed to estimate the present value of energy and other future costs. NIST also offers a computer program to calculate the life-cycle costs of capital investments in buildings and building systems that are intended to reduce future operating, maintenance, and energy costs. The Building Life-Cycle Cost (BLCC) computer program can be used to compute LCCs for different alternatives and compare alternatives for the lowest LCC or SIR. More information on the BLCC computer program is provided in Appendix C.

4.9.4 Economic Analysis for Discrete Projects in the CoF Program. An economic analysis is required to support each Program Direct and Mission Support discrete project in the CoF Program, including those involving energy-efficiency improvements. Economic analyses for discrete CoF projects must be prepared using the ECONPACK software package developed by the U.S. Army Engineering and Support Center, Huntsville, Alabama. ECONPACK is a comprehensive economic analysis tool containing standardized life-cycle methodologies and calculations for evaluating a broad range of capital investments. The package also provides a straightforward methodology for including the cost of cost of doing nothing, which must be included in all analyses to provide a common footing for establishing the economic value of construction projects and the construction program as a whole. The ECONPACK software package uses the prescribed procedures defined in OMB Circular A-94. Appendix C contains information on how to obtain the ECONPACK software.

CHAPTER 5. Efficient Facilities Operations and Maintenance (O&M)

5.1 Facilities Maintenance

5.1.1 Maintenance is one of the most cost-effective methods for ensuring energy conservation. Inadequate maintenance of energy-using systems is a major cause of energy waste in both the Federal and private sectors. Energy losses from leaks, uninsulated lines, maladjusted or inoperable controls, and other losses from poor maintenance are often considerable. Good maintenance practices can generate substantial energy savings. Also, improvements to physical plant maintenance programs can often be accomplished immediately and at a relatively low cost.

5.1.2 In order to ensure energy efficiency, NASA facilities shall be maintained in accordance with NDP 8831.1D, "Management of Institutional and Program Facilities and Related Equipment" and NPR 8831.2D, "Facilities Maintenance Management.

5.2 Facilities Operations

5.2.1 Section 101-20.107, Energy Conservation, of the Federal Property Management Regulations (41 CFR Part 101) These building operations standards contained in the regulation address lighting intensities, heating and cooling ranges, and ventilation levels.

5.3 Emergency Electricity Reductions at Federal Facilities

5.3.1 On May 3, 2001, the President issued a Memorandum for the Heads of Executive Departments and Agencies directing them to take the following actions:

a. Conserve energy use at facilities to the maximum extent consistent with the effective discharge or public responsibilities.

b. Conserve electricity during periods of peak demand in regions where electricity shortages are posible.

c. Review existing operating and administrative processes and conservation programs and identify and implement ways to reduce energy use.

5.3.2 In times of regional power shortages, Center shall comply with the emergency electricity reduction procedures issued by DOE in response to the President's memorandum. These manadatory procedures are contained in Appendix B.

CHAPTER 6. Energy-Efficient Technologies

6.1 Technology Requirements

6.1.1 Energy-efficient technologies enable significant energy savings, prevent pollution, and reduce waste without compromising the quality of performance. Several Federal programs have been implemented to foster the deployment of energy-efficient technologies and educational support to ensure technology acceptance. The following describes required measures regarding acquisition and use of energy-efficient technologoes in NASA facilities.

6.2 Reserved.

6.3 Heating, Ventilating, and Air Conditioning (HVAC)

6.3.1 General. When acquiring energy-using products, including building components and office equipment, Federal agencies are required to select ENERGY STARÂ® products and products that are in the upper 25 percent of energy efficiency where cost-effective. ENERGY STARÂ® and other Federal product efficiency recommendations are maintained on the DOE Federal Energy Management Program (FEMP) Web site at http://www.eren.doe.gov/femp/procurement/begin.html#bottom. When specific product efficiency recommendations are not available, the prescriptive standards established in 10 CFR 435 should be followed.

6.3.2 Reserved.

6.3.3 Reserved.

6.3.3.1 Reserved.

6.3.3.2 Reserved.

6.3.3.3 Reserved.

6.3.4 Reserved.

6.3.5 Reserved.

6.3.5.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

6.3.5.2 Reserved.

6.3.6 Reserved.

6.3.6.1 Reserved.

6.3.6.2 Reserved.

6.3.6.3 Reserved.

6.3.6.4 Reserved.

6.3.7 Reserved.

6.3.8 Reserved.

6.3.8.1 Reserved.

6.3.8.2 Reserved.

6.3.9 Reserved.

6.3.9.1 Reserved.

6.3.9.2 Reserved.

6.3.9.3 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

6.3.10 Reserved.

6.3.10.1 Reserved.

6.3.10.2 Reserved.

6.3.11 Reserved.

6.3.11.1 Reserved.

6.4 Lighting

6.4.1 Reserved.

6.4.2 Reserved.

6.4.2.1 Incandescent Lamps. Incandescent lamps have a low initial cost and good color-rendering properties, but they typically have the shortest life of all lamps and are the least efficient with efficacies in the range of 5 to 20 lumens per watt. The use of these lamps should be restricted to situations when more efficient lamps cannot attain the desired color, lumens, or distribution characteristics.

6.4.2.2 Reserved.

6.4.2.3 Reserved.

6.4.2.4 Reserved.

6.4.2.5 Reserved.

6.4.2.6 Reserved

6.4.3 Ballasts

6.4.3.1 Reserved.

6.4.3.2 Federal regulations established in 1988 apply to all ballasts manufactured on or after January 1, 1990, and to all ballasts sold by manufacturers on or after April 1, 1990, and to all ballasts incorporated into luminaire on or after April 1, 1991. These regulations forbid the use of "standard" electromagnetic ballasts and require the use of high-efficiency, energy-saving electromagnetic or electronic ballasts.

6.4.4 Lamps and Ballast Disposal. Lighting retrofits will involve the disposal of lamps and ballasts. Due to the mercury content of fluorescent lamps and the PCB content of ballasts, special handling is required. 40 CFR 761 and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) contain regulations on the proper disposal of PCBs and other hazardous waste. Each State has varying regulations and standards for the removal, handling, and disposal of hazardous waste. It is best to contact the local hazardous waste agency for proper instructions.

6.4.5 Exit Lights. Self-luminous signs that contain tritium gas, a low-level isotope of hydrogen shall note be installed because of potential disposal liability issues. To ensure adequate visibility, exit signs must meet or exceed visibility guidelines established by the National Fire Protection Association (NFPA) Life Safety Code 101, and other applicable building code requirements.

6.4.6 Reserved.

6.4.6.1 Reserved.

6.4.6.2 Reserved.

6.4.6.3 Reserved.

6.4.6.4 Reserved.

6.5 Reserved.

6.5.1 Reserved.

6.5.1.1 Reserved.

6.5.1.2 Reserved.

6.5.1.3 Reserved.

6.5.1.4 Reserved.

6.5.1.5 Reserved.

6.6 Reserved.

6.6.1 Reserved.

6.6.2 Reserved.

6.6.2.1 Reserved.

6.6.2.2 Reserved.

6.6.2.3 Reserved.

6.6.3 Reserved.

6.6.3.1 Reserved.

6.6.3.2 Reserved.

6.6.3.3 Reserved.

6.6.4 Reserved.

6.7 Reserved.

6.7.1 Reserved.

6.7.2 Reserved.

6.8 Reserved.

6.8.1 Reserved.

6.8.2 Reserved

a. Reserved.

b. Reserved.

c. Reserved.

6.8.3 Reserved.

6.8.3.1 Reserved.

6.8.3.2 Reserved.

6.8.3.3 Reserved.

6.8.3.4 Reserved.

6.8.3.5 Reserved.

6.8.3.6 Reserved.

6.8.3.7 Reserved.

6.9 Reserved.

6.9.1 Reserved.

6.9.2 Reserved.

6.9.2.1 Reserved.

6.9.2.2 Reserved.

6.9.2.3 Reserved.

6.9.2.4 Reserved.

6.9.2.5 Reserved.

6.10 Reserved.

6.10.1 Reserved.

6.10.1 Reserved.

6.11 Reserved.

6.11.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

6.11.1.1 Reserved.

6.11.1.2 Reserved.

6.11.1.3 Reserved.

6.11.1.4 Reserved.

6.11.2 Reserved.

6.11.3 Reserved

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

6.11.3.1 Reserved

a. Reserved.

b. Reserved.

6.12 Reserved.

6.12.1 Reserved.

6.12.2 Reserved.

6.12.3 Reserved.

CHAPTER 7.

RESERVED

CHAPTER 8. Water Conservation

8.1 Introduction

Water conservation is the planned management of water to prevent exploitation, destruction, or neglect of water resources. Water conservation management is a relatively new science that incorporates audits of resources and uses of water, water-saving solutions, installation of water-saving solutions, and verification of water-cost savings. [19] This paragraph discusses water conservation, its relation to energy conservation, and its effects as seen from different perspectives. It also describes different types of water conservation measures and outlines the six steps involved in assembling an integrated and cost-effective water conservation program.

8.2 Reserved.

8.2.1 Reserved.

8.2.2 Reserved.

8.2.3 Reserved.

8.2.4 Reserved.

8.3 Water Conservation Requirements

8.3.1 The DOE established Federal water conservation goals under the authority of Executive Order 13123. The goals require Federal agencies to reduce potable water usage by implementing cost-effective water efficiency programs that include a water management plan and not less than four of ten separate water efficiency improvement Best Management Practices (BMP). The ten BMPs are listed below and described in Appendix V:

a. BMP # 1 - Public Information and Education Programs

b. BMP # 2 - Distribution System Audits, Leak Detection & Repair

c. BMP # 3 - Water Efficient Landscape

d. BMP # 4 - Toilets and Urinals

e. BMP # 5 - Faucets and Showerheads

f. BMP # 6 - Boiler/Steam Systems

g. BMP # 7 - Single-Pass Cooling Systems

h. BMP # 8 - Cooling Tower Systems

i. BMP # 9 - Miscellaneous High Water-Using Processes

j. BMP #10 - Water Reuse and Recycling

8.3.2 BMPs are considered implemented at a facility when all the following criteria are met:

a. Water management plans have been developed or revised and incorporated into existing facility planning processes and operating plans. Center water management plans should be incorporated into the Center Energy Efficiency and Water Conservation 5-Year Plans described in paragraph 3.2.

b. Applicable O&M options have been put into practice, and retrofit/replacement options have been reviewed within the last 2 years and those appropriate for implementation have been identified.

c. Applicable cost-effective retrofit/replacement options have been implemented.

8.4 Reserved.

8.4.1 Reserved.

8.5 Reserved.

8.5.1 Reserved.

8.5.2 Reserved.

8.5.3 Reserved.

8.5.3.1 Reserved.

8.5.3.2 Reserved.

8.5.3.3 Reserved.

8.5.3.4 Reserved.

a. Reserved.

(1) Reserved.

(2) Reserved.

(3) Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

8.5.3.6 Reserved.

8.6 Reserved.

8.6.1 Reserved.

8.6.2 Reserved.

8.6.2.1 Reserved.

8.6.2.2 Reserved.

8.6.2.3 Reserved.

8.6.2.4 Reserved.

8.6.3 Reserved.

8.6.3.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

8.6.3.2 Reserved.

a. Reserved.

b. Reserved.

8.6.3.3 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

8.6.4.

8.6.4.1 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e.Reserved.

8.6.4.2 Reserved.

a. Reserved.

b. Reserved.

8.6.4.3 Reserved.

a. Reserved.

b. Reserved.

8.6.4.4 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e.Reserved.

8.7 Reserved.

8.7.1 Reserved.

8.7.2 Reserved.

8.7.2.1 Reserved.

8.7.2.2 Reserved

a. Reserved.

b. Reserved.

c. Reserved.

8.7.2.3 Reserved.

8.7.2.4 Reserved.

8.7.2.5 Reserved.

8.7.2.6 Reserved.

8.7.2.7 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

8.7.2.8 Reserved.

8.7.2.9 Reserved.

8.7.2.10 Reserved.

8.7.2.11 Reserved.

8.7.2.12 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

(1) Reserved.

(2) Reserved.

e. Reserved.

8.7.2.13 Reserved.

8.7.2.14 Reserved.

8.7.2.15 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

f. Reserved.

g. Reserved.

8.7.2.16 Reserved.

a. Reserved.

b. Reserved.

8.7.2.17 Reserved.

8.7.2.18 Reserved.

8.7.2.19 Reserved.

a. Reserved.

b. Reserved.

8.7.3 Reserved.

8.7.3.1 Reserved.

8.7.3.2 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

8.7.3.3 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

8.7.3.4 Reserved.

8.7.3.5 Reserved.

8.7.3.6 Reserved.

8.7.3.7 Reserved.

8.7.3.8 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

8.7.3.9 Reserved.

8.8 Reserved.

8.8.1 Reserved.

8.8.2 Reserved.

8.9 Water Conservation Program

8.9.1 General. This paragraph describes a step-by-step approach for designing a water conservation program.

8.9.2 Provide for User/Occupant Involvement. Personnel who will be affected by a water conservation measure need to accept the measure in order for it to be successful. It is essential that personnel have the opportunity to be involved in the measure's screening and assessment. Information on personnel acceptance may be available from other Centers that have implemented similar measures. If not, collect input directly from the affected personnel through personal or group interviews. Provide as much information as possible to the participants about the proposed measures and estimated water and energy savings. With the participant's feedback, the design of the proposed measure can be refined to improve acceptance.

8.9.3 Research Regulatory Requirements. State and local conservation regulations may be more stringent than federal regulations, especially in drought-prone areas. In these areas, it may be good public relations to be seen by the public as a partner rather than an adversary. This could mean adhering to local water conservation regulations even if federal facilities are not required to do so.

8.9.4 Establish Conservation Goals. EPACT does not specify water conservation goals. It only requires that all cost-effective water conservation measures be implemented. "Cost-effective" is defined as any measure with a payback period of less than 10 years. Federal water conservation goals established by DOE in response to Executive Order 13123 are based on implementing appropriate BMPs. Center-specific water usage reduction goals may be adopted, if deemed beneficial to the water management program.

8.9.5 Select BMPs for Implementation.

8.9.5.1 Select BMPs that are Applicable, Feasible, and Acceptable. Based on type of end use, determine which BMPs are appropriate to the end use and the physical characteristics of the site. Determine which are initially feasible by the benefit/cost analysis and ensure that the BMPs will be acceptable to Center management.

8.9.5.2 Select Measures with Acceptable Noneconomic Impacts. In addition to the economic impacts of water savings, a water conservation measure may have a number of noneconomic impacts. These impacts may include environmental, social, and others relating to the water user. A number of methods can be used for "ranking" impacts in the evaluation. Use a simple and uniform ranking system for the entire evaluation to help identify feasible and nonfeasible alternatives. This system is also referred to as a "qualitative evaluation." One approach to a qualitative evaluation is to make a comprehensive list describing each of the impacts. Next, determine whether the impact is positive, negative, or neutral. This type of assessment might reveal the positive environmental impacts of an economically nonfeasible conservation measure. Those positive noneconomic impacts may be considered significant enough to make an economically borderline project successful.

8.9.5.3 Determine the Conservation Potential of Selected BMPs. The last step before estimating the economic benefits and costs of each BMP is to determine its water and energy conservation potential. This determination involves comparing end use water consumption without the BMP (the status quo) with the expected water use after the BMP is implemented. The conservation potential figure can be determined for any period of time. Once a conservation potential figure is calculated, it can be further extrapolated by the number of fixtures and operating time.

8.9.6 Estimate Benefits and Costs. The life-cycle costing methods and procedures delineated in 10 CFR Part 436, described in paragraph 4.9, should be used to determine the cost-effectiveness of implementing potential BMPs.

8.9.7 Reserved.

8.9.7.1 Reserved.

a. Reserved.

(1) Reserved.

(2) Reserved.

(3) Reserved.

(4) Reserved.

b. Reserved.

(1) Reserved.

(2) Reserved.

(3) Reserved.

(4) Reserved.

(5) Reserved.

(6) Reserved.

(7) Reserved.

(8) Reserved.

8.9.7.2 Reserved.

a. Reserved.

b. Reserved.

(1) Reserved.

(2) Reserved.

(3) Reserved.

8.10 Reserved.

8.10.1 reserved.

CHAPTER 9. Energy Savings Performance Contracting (ESPC)

9.1 The ESPC Concept

9.1.1 General. The ESPC financing option allows Federal facilities to purchase energy efficiency, renewable energy, and water conservation technologies and services from private vendors through a shared savings approach. Under the ESPC method, the selected energy services company (ESCO) incurs the costs of implementing energy savings measures, including the cost of energy audits; project design; acquiring, installing, operating, and maintaining equipment; and training O&M personnel. The ESCO is given a share of the energy savings resulting directly from implementing such measures during the multiyear term of the contract. After paying the ESCO, the remaining savings are shared equally between the Center and the United States Department of the Treasury (USDT), as shown in Figure 9-1.

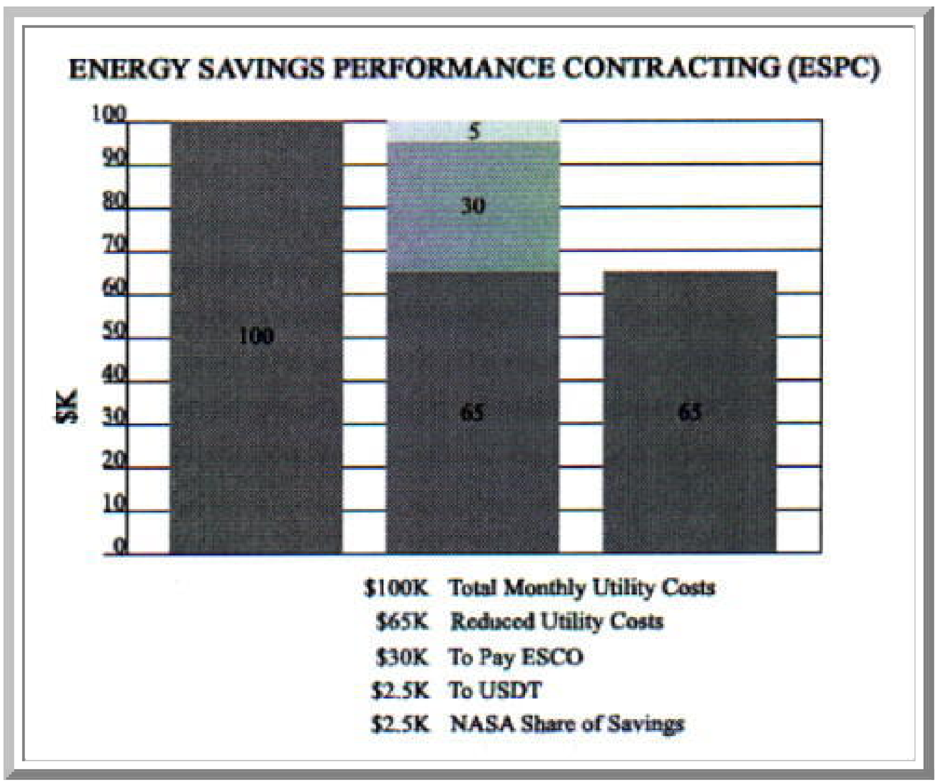


Figure 9-1. ESPC Example

9.1.2 Benefits. The key benefits of ESPC are that it:

a. Reduces energy consumption.

b. Improves Federal energy efficiency and helps meet the Federal energy savings requirements.

c. Reduces the maintenance and repair costs associated with aging or obsolete energy-consuming equipment.

d. Places O&M responsibilities on the contractor.

e. Stimulates the economy by allowing ESCO's to profit from their up-front investments in federally owned buildings by receiving a share of the utility bill savings.

9.1.3 Enabling Legislation for ESPC. EPACT directed the Department of Energy to develop methods and procedures to bring ESPC into the mainstream of Federal procurement. ESPC, formerly known as shared energy savings contracting, is an alternative to the traditional method of funding energy efficiency improvements in Federal buildings through direct appropriations. ESPC allows Federal agencies to update aging building systems, streamline operations, and train maintenance workers to reduce operating costs. Agencies can use future energy savings to fund projects, freeing up money currently wasted on energy inefficiency and making it available for facility improvements and sustained maintenance. ESPC can be used to:

a. Replace aging equipment with newer, more efficient products.

b. Help meet the energy reduction goals of Executive Order 13123 and EPACT.

c. Conserve nonrenewable fuels and achieve environmental benefits by reducing energy consumption.

d. Achieve utility cost avoidance without sacrificing service.

9.2 Statutory Requirements

9.2.1 Congressional Notification. A Federal agency may enter into a multiyear ESPC for a period not to exceed 25 years, without funding of cancellation charges before cancellation, provided such contract was awarded in a competitive manner pursuant to the above qualification procedures, and funds are available and adequate for payment of the costs of such contract for the first fiscal year. In addition, if the ESPC contains a clause setting forth a cancellation ceiling in excess of $10,000,000, the agency head must provide written notification to the appropriate authorizing and appropriating committees of Congress of the proposed cancellation ceiling, at least 30 days before the award of that contract.

9.2.2 Qualified ESCO's. Current statute states that a Federal agency may develop a list of ESCO's qualified to provide ESPC services, based on qualification statements provided by those ESCO's, which contain, as minimum, the ESCO's prior experience, capabilities to perform the proposed types of energy savings services and financial information. ESCO's may then be selected to conduct discussions concerning particular proposed energy savings projects, including requesting a technical and price proposal from such selected ESCO's, and select from those ESCO's, the most qualified to provide ESPC services based on technical and price proposals and any other relevant information. The list of qualified ESCO's must be updated at least annually.

9.2.3 Guarantee of Savings. The ESCO shall only be compensated for actual, measurable energy savings, hence, the ESPC must accurately define the energy baseline, or projected energy use, had the ESPC project not been implemented and the method with which savings will be measured. Additionally, an annual energy audit must be conducted to verify savings and ensure payments are accurate. The measurement technique will be based on project complexity: the savings from the replacement of lighting systems may not need to be metered, whereas heating modifications most likely would. In some cases, consideration must be given to other factors that affect energy demand, such as changes in mission, population, space utilization or weather.

9.2.4 Unsolicited Proposals. A Center may permit receipt of unsolicited proposals for ESPC services from an ESCO outside the scope of the Super ESPC process provided that the Center has determined that the ESCO is qualified to provide such services. ESCO qualification is usually determined by the ESCO meeting the requirements of the national ESCO qualification program administered by DOE. Prior to accepting an unsolicited ESCO proposal, the Center must place a notice in the Commerce Business Daily announcing that it has received such a proposal and invite other similarly qualified ESCO's to submit competing proposals. The Center may enter into an ESPC with such a qualified and competing ESCO, consistent with established procedures and methods.

9.3 DOE's Super ESPC Program

9.3.1 General. To make it easier for agencies to use ESPC, FEMP developed the Super ESPC, based on the Indefinite Delivery Indefinite Quantity (IDIQ) provision of the Federal Acquisition Regulation (FAR). Super ESPC's are regional IDIQ contracts that allow agencies to negotiate site-specific ESPC delivery orders with an ESCO without having to start the contracting process from scratch. In this way, agencies can issue delivery orders for their own ESPC projects through an established, Governmentwide IDIQ contract, saving time as well as energy and money. Before Super

ESPCs, facility personnel had to do their own contracting for energy and cost-saving projects. This process took as long as 18 months. Super ESPCs can reduce the time required to as little as three to six months. In addition, DOE technical and contract specialists can provide assistance on a reimbursable basis to guide agency personnel through the process step by step. More information on the Super ESPC initiative can be found at http://www.eren.doe.gov/femp.

9.3.2 Developing Delivery Orders under Super ESPC. Federal agencies that desire to implement a renewable energy or energy efficiency project may choose to place a delivery order for facilities located in the region covered by the Super ESPC. Federal agencies interested in participating in the DOE Super ESPC program will sign a Memorandum of Understanding (MOU) with DOE. NASA and DOE have already established an MOU at the agency level. DOE may authorize NASA Centers to place delivery orders itself, or may place the order on behalf of the Center. Centers can tailor the delivery orders to meet their site specific conditions and needs. Delivery orders issued under the contract are limited to the ESCO's that were competitively selected for the Super ESPC program. The ESCO's submit proposals for projects in response to delivery order requests for proposals. The authority to sign delivery orders under these contracts must be delegated to the Center by the DOE procuring contracting officer. More detailed information and a copy of the most recent version of the publication entitled, *Delivery Order Guidelines,* may be obtained from the FEMP Web site.

9.3.3 Interagency Agreement. An Interagency Agreement (IA) between DOE and the Center is always required before the Center can issue a delivery order against the Super ESPC for a specific project or projects. The IA provides the agreement of the parties on the division of responsibilities relative to pursuing a delivery order award or awards at Center site(s). At a minimum, the IA should include the following:

a. A statement of work describing the services to be provided to the Center by DOE.

b. A letter verifying that the Center has the funds to reimburse DOE for services provided under the IA in support of the delivery order. A reimbursable services schedule is included in the Super-ESPC Delivery Order Guidelines available from DOE FEMP.

9.3.4 Delivery Order Process. Centers are responsible for being diligent in the selection and implementation of projects for delivery orders. Centers must first assess the needs and requirements of their facilities. Prior to initiating a delivery order, agencies must consider: 1) facility closure or expansion; 2) environmental constraints (CFCs, PCBs, asbestos); 3) mission changes; 4) conflicts with other contracts; 5) economic analysis and project feasibility; and 6) any other unique facility issues. Centers must decide whether an ESPC is the appropriate contractual vehicle for fulfilling their requirements. In addition, Centers must assure that the delivery orders and projects implemented are consistent with the ESPC legislation and regulations. To assist Centers in making these decisions, the DOE Contract Specialist, Procuring Contracting Officer (PCO) and Contracting Officer's Representative (COR) are available to answer questions and arrange for technical assistance to agencies. In addition, the DOE offers training courses to help agencies in making decisions and in implementing projects.

9.3.5 Contents of a Delivery Order.

9.3.5.1 The following is a list of the documents needed to initiate, process and monitor a delivery order:

a. IA between DOE and the Center.

b. Site Technical Data Package (STDP).

c. Delivery Order Request for Proposal (DO RFP), or Delivery Order Project Description and Requirements (DO PDR).

d. Delivery Order Selection Document.

e. Funding Document.

f. Delivery Order Performance Evaluation.

9.3.5.2 Once it has been determined that there is a Center need and a Center can use the Super ESPC, there are two approaches to award a delivery order. Awards may be made for projects that have been identified by the Government or the ESCO, as described below:

a. Government-Identified Project. Once a Center has identified a project and determined whether or not the economics of the project allow for its viability, it begins the preparation of a DO RFP. The Center then determines whether to issue the RFP competitively or single source. Noncompetitive award determinations must be documented using the procedures described in paragraph 9.3.5.2.c. below. Once this determination has been made, and the DO RFP issued, the proposals are received, and evaluated. Then the Center selects the ESCO (if the DO RFP was issued competitively) and determines whether preaward requirements have been met. If requirements have been met, negotiations and award follow. If they have not been met, the Center goes to the next highest ranked ESCO giving consideration to price and technical factors (if DO RFP was issued competitively) or reissues the DO RFP to other Super ESPC ESCO's (if DO RFP was issued single source).

b. ESCO-Identified Project. The ESCO-identified project route is included in Super ESPCs to incorporate the intent of the ESPC legislation (42 U.S.C. 8287). The legislation encourages ESCO's to initiate projects with the Federal agencies. The procedure for ESCO-identified projects is similar to Government-identified projects. The difference is primarily in the beginning stages. With an ESCO-identified project, the ESCO must request COR approval to submit a proposal to the Center. If approval is given, the ESCO submits an initial proposal and the Center decides whether to pursue the requirement. If the decision is made to pursue the project, another decision on whether to issue the project description and requirements (PDR) single source to the originating ESCO or to compete is made based on the evaluation of the ESCO's proposal. If the Center decides to compete, a DO RFP is required to define site and Center specific and administrative requirements. At this point, the steps are the same, whether Government or ESCO-identified.

c. Noncompetitive Determination. If the agency decides to issue the DO RFP noncompetitively, the Contracting Officer must prepare a memorandum that provides the basis for supporting the single source determination. It is not necessary that a formal justification and approval document be prepared. The technical rationale for the Government's decision shall be emphasized. The requirements of 41 U.S.C. 253 and FAR 16.505 govern the decision to issue a DO RFP by either noncompetitive or competitive means. The following are the five exceptions to issuing a competitive DO RFP:

(1) Competition is precluded by the urgency of the requirement;

(2) The requirement is for installation, operation and maintenance of energy conservation measures (ECMs) that are highly specialized and only one contractor can provide the ECMs at the level of quality required;

(3) The requirement is a ESCO-identified project;

(4) It is necessary to place an order to satisfy a minimum guarantee under the Super ESPC contract; and

(5) The requirement is a logical follow-on to a delivery order previously issued to a contractor on a competitive basis.

9.3.6 The Contracting Process

9.3.6.1 The cognizant CO sends out the notice of intent to award to the selected ESCO and notifies the unsuccessful offerors if the selection was made on a competitive basis. The notice of intent to award letter specifies a time frame within which the selected offeror must conduct the detailed energy survey of facilities and energy systems at the project site.

9.3.6.2 Whether single source or competitive, the Center selects an awardee for the delivery order project as the "conditional" winner. The selected ESCO must meet certain preaward requirements, primarily the ESCO verification that it can meet the proposed guaranteed annual cost savings. The ESCO performs the detailed energy survey of the facilities and energy systems at the project site and provides a report in accordance the contract.

9.3.6.3 The detailed energy survey will verify the accuracy, and ability to achieve the estimated annual cost savings as originally proposed. The guaranteed savings may be revised by the ESCO after the survey, but it must be within the percentage specified in the DO RFP when compared to the "proposed" guaranteed savings provided in the initial proposal.

9.3.6.4 The Center reviews and approves the report and confirms that the schedules are consistent with the report findings. The Government's review and approval of the detailed survey report establishes the basis of the mutual agreement on the energy and facility baseline conditions. Therefore, careful review and approval of the report prior to acceptance is critical as the report will be the basis of the data used in negotiating guaranteed savings and contractor payments for the term of the delivery order. The Center should verify that all schedules are consistent with the report results.

9.3.6.5 The cognizant Government CO and technical representatives conduct negotiations with the selected ESCO. These schedules will be incorporated into the award as will any new or revised technical requirements/specifications as a result of the detailed energy survey.

9.3.6.6 Once negotiations are completed successfully, the ESCO confirms financing and bonding for the project. The Center then issues congressional notification, if applicable. The statute only requires that Congress be notified if the cancellation ceiling of the delivery order exceeds $10,000,000.

9.3.6.7 Once the ESCO's proposal has been reviewed by the Center, cognizant Government technical representatives, and the cognizant CO, the CO awards the delivery order. If the DOE is signing the delivery order, the Center must provide DOE with a funding document evidencing that funds for the first year's payments are committed.

9.4 Establishing the Baseline

9.4.1 Purpose. The establishment of an agreed-upon baseline for energy savings is essential to the success of the ESPC. The baseline is used to estimate energy savings and thus to calculate payments to the ESCO. A baseline should be simple enough to serve as a basis for billing payments to ESCO's, yet sophisticated enough to differentiate between only those energy reductions that result from the ESCO's actions and reductions that occur from changes in building use and weather. Baselines should also be flexible enough to accommodate changes that occur after the ESPC has been signed (such as changes in building use or installation mission). The three basic methods for establishing a baseline are:

a. Energy calculations. Calculations are based on information about and energy consumption history of energy-using building systems and equipment.

b. Regression analysis. A statistical technique that uses historical data derived from meters to isolate one or more variables that affect energy use (resulting, for instance, in an equation that relates energy use to weather or building use variables). When historical, metered data are available, regression analysis defines energy use relative to the entire building and allows greater flexibility in making ECM recommendations.

c. Simulation. A sophisticated set of engineering calculations that attempts to forecast energy use on the basis of a building's size and shape, equipment, levels of insulation, and types of windows and doors.

9.4.2 Baseline Development. The baseline is developed from historical or estimated energy use data, drawn from a recent, 12-month period of preretrofit energy consumption (estimates are based on a detailed engineering analysis of the building and its systems/equipment). A refinement of this is a baseline averages three years worth of utility bills, normalized for weather. The baseline includes utility, occupancy, and other information that allows the baseline energy consumption to be accurately compared to the energy consumption after the retrofits. The baseline should contain the following occupancy information: the total area of conditioned space, and the number of hours the building is occupied. The energy bills are prorated to obtain calendar month consumption in order to match monthly energy consumption to monthly weather data, and the base load is calculated. The energy sources are calculated according to temperature sensitivity and ratio of consumption per degree day. For each month being evaluated, the baseline month is adjusted to reflect changes in weather, occupancy, equipment, and other variables.

9.4.3 Baseline Adjustment. If facility use changes, the baseline should be altered to reflect the change. Depending on the change, different methods are used to adjust the baseline. For example, if the hours of operation change, calculations involving hours are adjusted and all energy consumption calculations are recalculated. If the use of the building changes, such as warehouse to office, a mini-audit is performed to verify the changes and adjust the energy consumption of the systems and subsystems affected.

9.5 Performance Guarantee and Contractor Payments

9.5.1 Cost Savings.

9.5.1.1 Energy cost savings are defined as a reduction in the cost of energy used in Federally owned buildings from a base cost established by the contract. Energy cost savings may be achieved as a result of:

a. The lease or purchase of operating equipment or improvements, altered O&M, or technical services.

b. The more efficient use of existing energy sources by cogeneration or heat recovery.

9.5.1.2 The "split" of energy cost savings each year, and the method of determining the value of such savings, are specified in the contract and may vary from year to year. NASA Centers should structure ESPC contracts or delivery orders such that, to the greatest extent possible, all energy cost savings realized are used to pay annual contract costs. By using this approach, the Center will be able to eliminate the financial burden much faster and begin to retain all of the postcontract energy cost savings much sooner. In the event that excess annual cost savings remain after contract payments are made, 50 percent of such savings are to be retained utilizing reimbursable funds procedures. The retained funds may be used for other energy efficiency and water conservation activities as authorized by section 152 (f) of the Energy Policy Act (P. L. 102-486). The remaining 50 percent of savings shall be deposited in account 803220 (General Fund Proprietary Receipts).

9.5.2 Performance Guarantee. The ESPC should specify the terms and conditions of any Government payments and performance guarantees. The contract shall provide for a guarantee of savings to the Center and shall establish payment schedules reflecting such guarantee, taking into account any capital costs under the contract. Any such performance guarantee shall provide that the ESCO is responsible for maintenance and repair services for any energy related equipment, including computer software systems. Centers may incur obligation pursuant to such contracts to finance energy conservation measures, provided guaranteed savings exceed the debt service requirements.

9.5.3 ESCO Payments. Government payments may be made from annual utility and related O&M funds. The aggregate annual payments by a Center to the utilities and ESCO's, under an ESPC, may not exceed the amount that the Center would have paid for utilities and related operations, maintenance and repair costs, without the ESPC as estimated by the baseline procedure specified in that contract.

9.6 Measurement and Verification (M&V) Procedures

9.6.1 General. Energy savings performance M&V of installed energy conservation projects typically has two components:

a. Confirming that the baseline conditions are accurately defined, and the proper equipment/systems are installed and they have the potential to generate the predicted savings. This confirmation verifies the ECM's potential to perform.

b. Determining the actual energy savings achieved by the installed ECM, which verifies the ECM's performance.

9.6.2 M&V Methods. Verification of conditions before installation (baseline) and after installation (postinstallation) of the ECM is achieved by inspections, spot measurement tests, and/or commissioning activities. The general approach to determining energy savings involves comparing baseline and postinstallation energy use associated with a facility, or certain systems within a facility. Therefore, energy savings = baseline energy use - postinstallation energy use. As the ESPC program is based on pay for performance, each ECM or site covered by a delivery order has a site-specific verification plan to determine the achieved savings. For each site, the project baseline and postinstallation energy use are determined using one or more of the following M&V techniques described in paragraph 9.6.4.3.

9.6.3 M&V Protocols. M&V protocols have been defined by the U.S. Department of Energy for ESPC projects and task orders, as documented in *Measurement and Verification (M&V) Guidelines for Federal Energy Projects*. The ESCO should use the latest version of these guidelines for site-specific ECM M&V as applicable. In addition, simple monitoring utility bills can provide a general measure of the energy savings. However, utility bills must be monitored carefully as other factors affect overall energy usage, such as weather and occupancy levels.

9.6.4 General Approach to M&V.

9.6.4.1 The general approach to determining energy savings involves comparing energy use at the project site before the project is implemented and then assessing usage after the installation. The energy savings are calculated by subtracting postinstallation usage from the baseline energy usage. For each site, the project baseline and postinstallation savings are determined using various methods including bill analysis, metering, and/or engineering calculations. First year payments to the ESCO are based on projected savings estimated by the ESCO. After the first year, the ESCO must provide annual reports that contain the results of equipment performance assessment and analysis of actual usage data. Payments to the ESCO for the following year are then adjusted accordingly.

9.6.4.2 In a postinstallation M&V verification, the ESCO and Center agree that the proper equipment components or systems were installed, are operating correctly and have the potential to generate the predicted savings or renewable generation. Verification methods may include surveys, inspections, spot metering, and/or continuous metering. The ESCO and Center, at defined intervals during the term of the contract, will verify that the installed equipment components or systems have been properly maintained, continue to operate correctly, and to generate savings. It should be noted that under the ESPC program the verification of savings is required on an annual basis.

9.6.4.3 Either after the project is installed, continuously, or at regular intervals, the ESCO and Center will determine energy savings or renewable energy production in accordance with an agreed-to M&V method with the verification techniques that are defined in a site-specific M&V plan. Baseline energy use, postinstallation energy use, and thus energy (and cost) savings can be determined using one or more of the following M&V techniques:

a. Engineering calculations.

b. Metering and monitoring.

c. Utility meter billing analysis.

d. Computer simulations (e.g., DOE-2 analysis).

e. Mathematical models (e.g., regression formulas).

f. Agreed-to stipulations by the Center and the ESCO.

9.6.4.4 There are numerous factors that can affect energy savings during the term of a contract, such as weather, operating hours, process loads and heat exchanger fouling. In general, an ESPC objective will be to adjust the baseline energy use up or down for factors beyond the control of the ESCO (e.g., building occupancy or weather) and adjust the postinstallation energy use for ESCO-controlled factors (e.g., maintenance of equipment efficiency).

9.6.5 M&V Options.

The FEMP *Measurement and Verification Guidelines* are grouped into three categories, Options A, B, and C. These options are consistent with those defined in the North American Energy Measurement and Verification Protocols (NEMVP). Three options are provided in order to provide flexibility in determining energy savings. Selection of the appropriate M&V approach requires an evaluation of many interrelated parameters, including other ECMs implemented, existing utility submetering, and dynamic changes to the facility. The options differ in their approach to the level and duration of the retrofit verification measurements. For instance, Options A and B both focus at the system level, while Option C uses measurements taken at the whole-building, or whole-facility level. Option A uses short-term measurements, while Options B and C use continuous or regular interval measurements during the term of the contract. None of the options are necessarily better than the others. Each has advantages and disadvantages based on site specific factors and the needs and expectations of the Center. The three options are described below and summarized in Table 9-1. The Center and the ESCO will select an M&V option and method for each project and then prepare a site-specific M&V plan that incorporates project specific details.

Table 9-1. M&V Options Summary

M&V Option	Verification of Potential To Perform (and generate savings)	Verification of Performance (savings)	Performance Verification Techniques
Option A Verifying that the measure has the potential to perform and to generate savings	Yes	Stipulated	Engineering calculations (possibly including spot measurements) with stipulated values
Option B Verifying that the measure has the potential to perform and verifying actual performance by end use	Yes	Yes	Engineering calculations with metering and monitoring throughout term of contract

Option C Verifying that the measure has the potential to perform and verifying actual performance (whole building analysis)	Yes	Yes	Utility meter billing analysis, possibly with computer simulation ract

9.6.5.1 Option A.

a. Option A is a verification approach that is designed for projects in which the potential to perform needs to be verified, but the actual can be stipulated based on the results of the "potential to perform and generate savings" verification and engineering calculations. Option A involves procedures for verifying that:

(1) Baseline conditions have been properly defined.

(2) The proper equipment and/or systems have been installed.

(3) The installed equipment components or systems meet the specifications of the contract in terms of quantity, quality, and rating.

(4) The installed equipment is operating and performing in accordance with the specifications in the contract and meeting all functional tests.

(5) The installed equipment components or systems continue, during the term of the contract, to meet the specifications of the contract in terms of quantity, quality and rating, and operation and functional performance.

b. Option A, therefore, enables the contracting parties to confirm that the proper equipment components or systems were installed and that they have the potential to generate the predicted savings. Achieving this level of verification is all that is contractually required for certain types of performance contracts. Verification of the potential to perform may be done with inspections and/or spot or short-term metering conducted right before and/or right after project installation. Annual (or some other shorter, regular interval) inspections may also be conducted to verify the continued potential of the project to perform and generate savings.

c. With Option A, actual achieved energy or cost savings are predicted using engineering or statistical methods that do not involve long term measurements. All end-use technologies can be verified using Option A. Within Option A, various methods and levels of accuracy in verifying performance are available. The level of accuracy ranges from an inventory method of ensuring nameplate data and quantity of installed equipment to short-term measurements for verifying equipment ratings, capacity and/or efficiency.

9.6.5.2 Option B.

a. Option B is for projects in which the potential to perform and generate savings needs to be verified; and actual performance during the term of the contract needs to be measured (verified).

b. Option B involves procedures for verifying the same items as Option A plus verifying actual achieved energy savings during the term of the contract. Performance verification techniques involve engineering calculations with metering and monitoring. Option B M&V involves: confirming that the proper equipment/systems were installed and that they have the potential to generate the predicted savings, and determining an energy (and cost) savings value using measured data taken throughout the term of the contract.

c. How accurate the energy savings value must be is defined by the Center or negotiated with the ESCO. The steps used in measuring or determining energy savings can be more difficult and costly than those used in Option A; however, the results will typically be more precise. Methods used in this option will involve long term measurement of one or more variables. Long term measurement accounts for operating variations and will more closely approximate actual energy savings than the use of stipulations as defined for Option A. Long term measurements do not necessarily increase the accuracy.

9.6.5.3 Option C.

a. Option C is also for projects in which (1) the potential to perform needs to be verified and (2) actual performance during the term of the contract needs to be verified. Option C involves procedures for verifying the same items as Option A plus verifying actual achieved energy savings during the term of the contract.

b. Performance verification techniques involve utility whole building meter analysis and/or computer simulation calibrated with utility billing data. As such Option C is the one M&V option that addresses aggregate, coincident demand and energy savings from multiple resources at a single site. Option C also provides procedures for determining and verifying the impact of projects that are not directly measurable, or affect loads indirectly, such as increasing building insulation, or installing low-emittance windows.

c. Option C M&V involves confirming that the proper equipment/systems were installed and that they have the potential to generate the predicted savings, and determining an energy savings value using measured utility meter data taken throughout the term of the performance contract.

d. All end-use technologies can be verified with Option C. This option would be used when there is a high degree of interaction between installed energy conservation systems and/or the measurement of individual component savings would be difficult. Accounting for changes other than those caused by the project is the major challenge associated with Option C - particularly for long term contracts.

e. As noted previously, the level of certainty, and thus effort, required for verifying the potential to perform and actual performance will vary from project to project. Drafting of an RFP to select an ESCO or the actual contract should be done with serious consideration of M&V requirements, reviews and costs.

9.6.6 Submetering. Submetering of the system or subsystem that is being retrofitted with ECMs is another preferred method to for measuring and verifying energy savings. The systems are monitored both before and after the ECM installations. However, other factors affecting the energy consumption of the system need to be accounted for during the submetering period. The ESCO should perform an energy audit each year to monitor the energy savings and condition of the upgrades that provides a measure of the energy savings and ensures that the equipment is performing at optimum efficiency.

CHAPTER 10. Utility Energy-Efficiency Service Contracts (UESC) and Demand-Side Management (DSM) Programs

10.1 UESC

10.1.1 In addition to ESPC, EPACT and Executive Order 13123 authorize UESC as another alternative financing method for Federal energy efficiency and water conservation projects. These programs range from rebates on a piece of equipment all the way to delivering a complete turnkey project.

10.1.2 Services provided for a project can range anywhere from auditing to installation and commissioning, including financing the entire project. Utilities may cover the capital costs of the project in consideration of the energy savings the retrofits will produce. In this arrangement, the net cost to the Federal agency remains the same or less than the status quo, and the agency saves time and resources by using the "one-stop shopping" provided by the utility.

10.1.3 Many utilities offer their customers a wide range of products and services related to the implementation of energy efficiency and/or renewable energy projects. Typical offerings include: financing; financial incentives; rebates; and various technical services such as audits, engineering design, billing analysis, equipment procurement and installation, operation and maintenance, and M&V.

10.1.4 Typically, utility programs are site-specific and customized to the needs of a particular agency or facility. Negotiating the terms of the agreement with the utility can be time consuming. Contacting the utility is the best way to determine the programs that are available in a given region or to a given facility. Utility programs typically make use of the following agreement types:

a. Areawide Contracts (AWC). AWCs are agreements between GSA and a specific utility. Once GSA signs an AWC with a utility, any agency located in the utility's service territory can make use of it. In October 1995, a special authorization for energy management and energy efficiency was incorporated into the AWCs. With an AWC, the agency places their authorizations for a specific project under the AWC.

b. Basic Ordering Agreements (BOA). BOAs are agreements between any agency and a utility. Although GSA can place a BOA, agencies are free to place their own BOAs with local utilities. The procedure to use a BOA is to place delivery orders under the agreement, detailing the needs of a specific site.

c. Agency Model Agreements. The agency model agreement is a new type of agreement that has emerged over the last year. This agreement contains terms and conditions specific to a give agency. These terms and conditions can vary from agency to agency. Agencies can develop models through the Edison Electric Institute (EEI) to develop terms and conditions that are agreeable to both the agency and the utility. The DOD and EEI developed the first agency specific model agreement that became available in April 1997.

10.1.5 Additional information on utility partnership opportunities can be obtained directly from FEMP or the local utility.

10.2 DSM Programs

10.2.1 DSM programs are utility-sponsored programs that encourage modification of electric or gas energy consumption patterns through energy efficiency improvements and load management. Historically, utilities have subsidized DSM programs. However, in a competitive market, regulated utilities are forced to cut costs, which shifts the focus to revenue generating operations. There are still many offerings available to Centers. Energy managers should contact their local utility provider to check the status of DSM programs before proceeding with energy-related projects.

10.2.2 Reserved.

a. Reserved.

b. Reserved.

c. Reserved.

d. Reserved.

e. Reserved.

f. Reserved.

10.2.3 Reserved.

Appendix A.

RESERVED

Appendix B

RESERVED

APPENDIX C. Summary of Legislation and Executive Orders Fostering Federal Energy Efficiency

C.1 Legislation for Federal Facilities and Operations

C.1.1 Reference. Most of the following material is from the U.S. Congress Office of Technology Assessment (OTA), "Energy Efficiency in the Federal Government: Government by Good Example?," OTA-E-492, U.S. Government Printing Office, May 1991.

C.2.1 General. Congress has addressed the issue of improving energy efficiency in the facilities it owns and leases and in its operations several times since the mid-1970s. Each new piece of legislation has combined past experience with new approaches in an effort to promote further efficiency gains in Federal agencies.

C.2.2 Energy Policy and Conservation Act (EPCA), 42 U.S.C. 6201 et seq. The EPCA of 1975 was the first major piece of legislation to address Federal energy management, directing the President to develop a comprehensive energy management plan, including procurement practices, and a 10-year building plan. The EPCA included few details, leaving those to the executive branch. The EPCA also amended the Motor Vehicle Information and Cost Savings Act to require that the Federal automotive fleet meet or exceed the corporate average fuel economy mileage standards.

C.2.3 Department of Energy Organization Act (DOEOA), 42 U.S.C. 7101 et seq. Section 656 of the DOEOA of 1977 established the Federal Interagency Energy Policy Committee (often called the "656 Committee"). The 656 Committee is a senior agency management group comprising an assistant secretary or assistant administrator from each of the Departments of Defense, Commerce, House and Urban Development, Transportation, Agriculture, and Interior; from the U.S. Postal Service; and from the General Services Administration. The NASA and the Department of Veterans Affairs have also designated members for the committee. The committee is intended to strengthen energy conservation programs that emphasize productivity through the efficient use of energy and to concurrently encourage interagency cooperation in energy conservation. It meets periodically to discuss policy options and review agency progress toward Federal conservation goals. One of its purposes is to focus the attention of top Federal agency management on the tasks and missions related to national energy objectives rather than on the tasks of a particular agency.

C.2.4 National Energy Conservation Policy Act (NECPA), 42 U.S.C. 8251 et seq. In the NECPA of 1978, Congress took a more active role in defining detailed steps to be followed by the executive agencies. Several of the steps included in this legislation had been set forth by the President in Executive Order (EO) 12003 in 1977 (see below). For example, where the EPCA directed the President to develop an energy-related procurement policy, the NECPA specified the use of a "life-cycle costing methodology" as the basis of policy. Similarly, where the EPCA directed the President to develop a 10-year building plan, the NECPA included details such as which buildings were subject to energy audits (all those exceeding 1000 square feet). Both of these NECPA provisions were part of EO 12003. Unlike EO 12003, the NECPA set no goal for percentage reduction in energy use, but instead specified the minimum rate at which Federal buildings had to be retrofit with all cost-effective measures. All buildings were to have been retrofit by 1990. The main provisions of the NECPA were codified as the Federal Energy Initiative.

C.2.5 Federal Energy Management Improvement Act (FEMIA), Public Law 100-615. The FEMIA of 1988 amended the NECPA and modified and added several provisions to the Federal Energy Initiative. A central provision was the establishment of a goal to reduce energy consumption per square foot in Federal buildings by 10 percent between 1985 and 1995. Operations energy (i.e., energy used for transport or in energy-intensive activities such as nuclear reactors) was not included. FEMIA marked the first time that Congress specified the level of savings that should be achieved. Also, as an incentive to encourage use of SES contracts, Congress allowed agencies to retain a portion of cost savings for future energy conservation measures. Furthermore, the FEMIA created an Interagency Energy Management Task Force, and directed the Department of Energy (DOE) to carry out an energy survey in a representative sample of Federal buildings to: (1) determine the maximum potential cost-effective energy savings that may be achieved, and (2) make recommendations for cost-effective energy efficiency and renewable energy improvements.

C.2.6 Energy Policy Act of 1992 (EPACT), Public Law 102-486. EPACT Title I, Subtitle F, *Federal Agency Energy Management* , establishes Federal agency goals and requirements and amends the NECPA to reflect and supplement goals and requirements set forth in EO 12759. The EPACT:

a. Requires that all energy and water conservation measures with Life-Cycle Cost (LCC) paybacks of less than 10 years be installed in all Federal buildings by January 1, 2005.

b. Contains provisions regarding energy management requirements, LCC methodology, budget treatment for energy conservation measures, incentives for Federal agencies, reporting requirements, new technology demonstrations, and agency surveys of energy-saving potential.

c. Authorizes GSA to receive rebates, other incentive payments, or goods and services from utilities and deposit funds into the Federal Buildings Fund for use in energy management improvement programs; and requires GSA to report annually to Congress on its activities related to Federal agency energy management.

d. Amends sections of the NECPA relating to shared energy savings (SES), provides new language giving agencies authority to enter into energy performance contracts, and describes the methodology of contract implementation.

e. In regard to intergovernmental energy management planning and coordination, requires GSA, along with the Interagency Energy Management Task Force, to hold five conference workshops in FY93 on energy management, conservation, efficiency, and planning strategy, and to hold biennial workshops in each of the 10 standard Federal regions thereafter.

f. Requires Federal agencies to establish and maintain programs to train energy managers and to increase the number of trained energy managers within each agency. The Act defines a "trained energy manager" as "a person who has completed a course of study in the areas of: (1) fundamentals of building energy systems, (2) building energy codes and applicable professional standards, (3) energy accounting and analysis, (4) LCC methodologies, (5) fuel supply end pricing, and (6) instrumentation for energy surveys and audits."

g. Requires DOE to make available energy audit teams for Federal facilities and to establish programs to monitor the implementation of energy efficiency improvements based on energy audit team recommendations.

h. Directs the OMB to issue guidelines for accurately assessing energy use in Federal buildings or facilities to be used in agency reports to DOE, and directs GSA to report annually on the estimated energy costs for leased space in which the Government does not pay these costs directly.

i. Directs agency Inspectors General to assess agency compliance with existing energy management requirements as well as the accuracy of energy-use and cost data reported by Federal agencies, and encourages periodic review.

j. Directs GSA, DoD, and Defense Logistics Agency to identify energy-efficient products on the Federal supply schedules that offer significant potential for LCC savings.

k. Requires DOE to report to Congress on options for financing conservation measures, including an assessment of the investment required and the possible use of revolving funds.

l. Directs agencies to establish criteria for improving energy efficiency in Federal facilities operated by contractors and to include such criteria in all cost-plus, award-fee contracts.

m. Confirms and expands upon the activities and goals of Section 11 of EO 12759 dealing with Federal fleets. Amends the Alternative Motor Fuels Act (AMFA) to include all types of alternative fuels and all types of light duty trucks, and changes the definition of fleet to "20 or more vehicles in metropolitan areas of more than 250,000 people." Requires consideration of pollution-reduction potential, requires alternative fuel use in dual-fuel use, requires 50 percent domestic fuels, requires heavy-duty use and disposal reports, and repeals termination of the AMFA. Requires the use of commercial refueling facilities if available, but authorizes funds for refueling facilities if necessary.

n. Mandates fleet requirements for new acquisitions to the Federal fleet [i.e., FY93, 5,000 alternative-fuel vehicles (AFVs); FY94, 7,500 AFVs; FY95, 10,000 AFVs; FY96, 25 percent; FY97, 33 percent; FY98, 50 percent; and FY99, 70 percent]. Allows allocation of AFV incremental costs to be spread over all agency vehicles and authorizes funds as necessary for fiscal years 1993 to 1998.

o. Requires DOE and GSA to establish an agency promotion, education, and coordination program; allows GSA to offer leased AFVs at lower costs as an incentive for three years; requires GSA to establish a recognition and incentive program for Federal employees; directs GSA to measure the use of alternative fuels in dual-fuel vehicles; and reduces data collection required to a representative sample.

C.3 Executive Orders for Federal Energy Efficiency

C.3.1 Reference. The material in this paragraph is also mostly from the OTA except for EO's 12902, 13123, 13148, and 13149.

C.3.2 EO 11912, "Delegation of Authorities Related to Energy Policy and Conservation," 3 CFR (1976 Compilation). There have been several EO's related to Federal energy efficiency. The earliest was EO 11912 of 1976, which delegated authorities related to energy and conservation. Among other things, this order defined the following roles of various Cabinet Departments with responsibility for Federal energy use:

a. The Administrator of GSA was designated to take on the functions assigned to the President by the Motor Vehicle Information and Cost Savings Act, as amended, directing that rules be established to require the Federal fleet to achieve an average fuel economy of at least that applicable to vehicle manufacturers.

b. The Administrator of the Federal Energy Administration (now the Secretary of Energy) was made responsible for coordination of a 10-year energy conservation plan for Federal buildings, energy conservation and rationing contingency plans, and preparation of annual reports to be submitted to Congress as required by the EPCA.

c. The Administrator of the Office of Federal Procurement Policy was required to provide policy guidance for application of energy conservation and efficiency standards in the Federal procurement process as mandated by the EPCA.

C.3.3 EO 12003, "Relating to Energy Policy and Conservation," 3 CFR (1977 Compilation). EO 12003, issued in 1977, amended EO 11912 and aggressively expanded the requirements of the Energy Policy and Conservation Act of 1975. For example, it specified a goal of a 20 percent reduction in energy use per square foot in existing Federal buildings and required the Federal automobile fleet to exceed the minimum statutory requirement by 4 miles per gallon beginning in fiscal year 1980. As noted above, some of its provisions are also found in the NECPA. Key provisions of EO 12003 include the following:

a. The Administrator of the Federal Energy Administration (now the Secretary of Energy) was directed to accomplish the following:

(1) Develop, implement and oversee a 10-year energy conservation plan for Federal buildings over 5,000 square feet for the 1975 to 1985 period which would achieve a 20 percent reduction in energy use in existing buildings and a 45 percent reduction in all new buildings.

(2) Establish a life-cycle-cost methodology.

(3) Report to Congress annually on the progress of the plan.

b. The Administrator of GSA was directed to ensure the following:

(1) All passenger automobiles purchased by executive agencies exceed the manufacturers' corporate average fuel economy standard under the Motor Vehicle Cost and Information Act.

(2) The Federal passenger automobile fleet exceeds minimum statutory requirements by 2 miles per gallon in fiscal year 1978, and by 4 miles per gallon beginning in 1980.

(3) The Federal light truck fleet also meets minimum standards, although not required under the Motor Vehicle Cost and Information Act.

C.3.4 EO 12083, "Relating to Certain Functions Transferred to the Secretary of Energy by the Department of Energy Organization Act," 3 CFR (1978 Compilation). In 1978, EO 12083 created an Energy Coordinating Committee composed of the Secretaries of the major Federal agencies. Its mission is to assure Federal coordination on energy-related matters, including both policy initiatives and resource allocation. In addition to the committee, an Executive Council was formed consisting of the Secretary of Energy, Chairman of the Council of Economic Advisors, Assistant to the President for Domestic Affairs and Policy to fulfill the functions of the committee during periods when the committee was not meeting.

C.3.5 EO 12375, "Motor Vehicles," 3 CFR (1982 Compilation). EO 12375 of 1982 further amended EO 11912 to reduce the required Federal passenger automobile fleet efficiency established in EO 12003. Whereas EO 12003 required the Federal passenger fleet to exceed manufacturers' average fleet efficiency by 4 miles per gallon, EO 12375 required only that the Federal fleet meet the manufacturers' average efficiency and that light trucks meet standards set by the Secretary of Transportation. This EO contrasted sharply with EO 12003, which was far more ambitious and went beyond some minimum requirements set by Congress.

C.3.6 EO 12759, "Federal Energy Management," 3 CFR (1991 Compilation). On April 17, 1991, EO 12759 was issued with provisions to accomplish the following:

a. Extend the FEMIA Federal building reduction goal to 2000, requiring BTU per gross square foot to be reduced 20 percent from 1985 levels.

b. Require agencies to prescribe policies for improving energy efficiency of industrial facilities by at least 20 percent in 2000 compared to 1985.

c. Minimize petroleum use.

d. Procure energy-efficient goods and products by Federal agencies based on life-cycle cost.

e. Provide for Federal agency participation in DSM services offered by utilities.

f. Provide new Federal vehicle fuel efficiency requirements and outreach programs.

g. Promote procurement of alternative fuel vehicles for the Federal fleet.

C.3.7 EO 12844, "Federal Use of Alternative Fueled Vehicles," 3 CFR (1993 Compilation). EO 12844, issued on April 21, 1993, requires the Federal Government to acquire alternative-fuel vehicles. (AFVs) in numbers that exceed the EPACT requirements (i.e., FY93, 7,500 AFVs; FY94, 11,250 AFVs; FY95, 15,000 AFVs; FY96, 35 percent; FY97, 40 percent; FY98, 60 percent; and FY99, 80 percent).

C.3.8 EO 12845, "Requiring Agencies to Purchase Energy Efficient Computer Equipment," 3 CFR (1993 Compilation). EO 12845, issued on April 21, 1993, establishes energy-efficient acquisition standards for computer equipment. Microcomputers, including personal computers, monitors, and printers, must meet the EPA ENERGY STAR(r) requirements for energy efficiency (i.e., a standby low power feature) so long as the additional costs of the equipment are offset by the potential energy savings. Exemptions to this requirement are permitted on a case-by-case basis (as approved by the Agency Head). Note: All exempted acquisitions must be reported annually to the General Services Administration.

C.3.9 EO 12902, "Energy Efficiency and Water Conservation at Federal Facilities," 3 CFR (1994 Compilation). On March 8, 1994, EO 12902 was issued with provisions to accomplish the following:

a. Expand the Federal building reduction goal from the previous 20 percent of BTU per gross square foot by the year 2000 from 1985 levels to 30 percent by the year 2005.

b. Require agencies to develop and implement a program to increase energy efficiency in industrial buildings by at least 20 percent by the year 2005 as compared to the 1990 benchmark, to the extent these measures are cost-effective. Also, all cost-effective water conservation projects are to be implemented in these facilities.

c. Require agencies to conduct prioritization surveys for energy and water of all their facilities within 18 months of the date of this order. A prioritization survey was defined as a rapid assessment that will be used to identify those facilities with the highest priority projects based on the degree of cost-effectiveness and to schedule comprehensive facility audits prior to project implementation.

d. Require agencies to develop and begin implementing a 10-year plan to accomplish comprehensive facility audits based on the prioritization surveys. Approximately 10 percent of facilities are to be completed each year.

e. Require agencies to develop and implement a plan to improve energy and water efficiency in exempt, i.e., mission variable, facilities. Also, the prioritization surveys are to provide a basis for agencies to refine their designation of facilities as exempt.

C.3.10 EO 13031, "Federal Alternative Fueled Vehicle Leadership," 3 CFR (1996 Compilation). EO 13031, issued on December 13, 1996, supersedes EO 12844 and reinstates the EPACT requirements for acquisition of alternative fueled vehicles by Federal agencies (i.e., 25 percent in FY 1996, 33 percent in FY 1997, 50 percent in FY 1998, and 75 percent in FY 1999 and thereafter). This requirement applies to general-purpose vehicles located in metropolitan statistical areas with populations of 250,000 or more. The acquisition requirements apply to vehicles leased from GSA, acquired directly from auto manufacturers, commercial leases, or conversion of conventionally fueled vehicles. The Order also establishes reporting credits for zero-emission vehicles and medium- and heavy-duty dedicated alternative fueled vehicles.

C.3.11 EO 13123, "Greening the Government Through Efficient Energy Management," 3 CFR (1999 Compilation). EO 13123, issued on June 3, 1999, supersedes EO 12902. This EO builds on and incorporates many of the provisions of EO 12902, expanding its scope and strengthening its management and implementation mechanisms. It increases the energy efficiency goal for buildings to a 35 percent reduction in energy consumption per gross square foot by 2010, compared to 1985. The EO enlarges the number of facilities subject to energy reduction goals by establishing new goals for energy-intensive facilities and by making exemption criteria more stringent. The EO also requires a 30 percent reduction in greenhouse gas emissions attributable to Federal facility operations by 2010, compared to 1990. The Order also includes explicit statements to increase the use of renewable energy, reduce the use of petroleum, and conserve water.

C.3.12 EO 13148, "Greening the Government Through Leadership in Environmental Management," 3 CFR (2000 Compilation). EO 13148, issued on April 21, 2000, supersedes several EO's and the Executive Memorandum on Environmentally Beneficial Landscaping of April 26, 1994. This EO requires Federal agencies to: 1) integrate environmental accountability into day-to-day decision-making and long-term planning processes across all agency missions, activities, and functions, 2) develop and implement environmental management systems and environmental compliance audit programs, 3) prevent or reduce pollution at its source, 4) reduce reported Toxic Release Inventory releases and offsite transfers of toxic chemicals for treatment and disposal by 40 percent by the end of 2006, 5) reduce the use of selected toxic chemicals, hazardous substances, or generation of pollutants by 50 percent by the end of 2006, 6) phase out the procurement of Class 1 ozone-depleting substances for all nonexempted uses by the end of 2010, and 7) promote sustainable management of Federal facility lands through environmentally sound landscaping practices.

C.3.13 EO 13149, "Greening the Government Through Federal Fleet and Transportation Efficiency," 3 CFR (2000 Compilation). EO 13149, issued on April 21, 2000, superseded EO 13031. This EO reiterates EPACT Section 303 requirements for acquisition of alternative fueled vehicles by Federal agencies (i.e., 75 percent of new vehicles acquisitions must be alternative fueled vehicles) and directs Federal agencies to take a leadership role in the reduction of vehicular petroleum consumption. In particular, each agency operating 20 or more motor vehicles within the United States, must develop and implement a strategy for reducing its entire vehicle fleet's annual petroleum consumption by at least 20 percent by the end of FY 2005, compared with FY 1999 petroleum consumption levels, through increases in fleet efficiencies and the use of alternative fuels. Agencies must ensure that alternative fueled vehicles are in operation and use alternative fuels a majority of the time. Agencies must also increase the average EPA combined fuel economy of new conventional light-duty vehicle acquisitions by 1 mpg by FY 2002 and 3 mpg by FY 2005, compared to FY 1999.

C.3.14 Executive Memorandum on Cutting Greenhouse Gases through Energy Savings Performance Contracts. This Executive Memorandum, dated July 25, 1998, directs all Federal agencies to: 1) maximize use of the Energy Saving Performance Contracting authority provided by EPACT; 2) propose ways to procure electricity produced using cost-effective renewable sources; 3) maximize efforts to earn ENERGY STAR(r) labels for facilities; and 4) use all available financing mechanisms to make Federal buildings more energy efficient and install renewable energy production systems, such as those called for in the Million Solar Roofs Initiative.

APPENDIX D. Plan Of Action for Emergency Electricity Reduction at Federal Facilities

General

1. Establish/enhance communications with the local utility company. Understand their needs for load reductions. Work with the local utility to develop the individual facility plan.

2. Identify load reduction measures appropriate for the facility. Investigate separating loads into: (1) Life, health and safety driven; (2) Mission critical; and, (3) Noncritical. If not separately switchable, investigate modifying systems to allow terminating or reducing noncritical loads.

3. Establish a system to alert employees of expected high demand days including, but not limited to E-mail, voice mail, or public address announcement to all employees. Communicate early to allow employees to take load reduction measures at home and to dress appropriately.

4. Monitor total facility demand and demands for individual major loads (if separate metering is available). Monitor weather forecasts to predict high demand days and be proactive in communicating with the local utility to assess need to reduce load.

5. Initiate load reduction measures. Employees can take steps to reduce lighting, personal computers and appliances electricity use. While energy efficiency should be encouraged on a daily basis, stress the need for increased diligence to alleviate the emergency. Heating and air-conditioning operating changes and other system-wide measures should be accomplished by facilities management. Federal facilities that have energy management and control systems are well suited for this task. Facilities should also consider additional measures appropriate for site specific circumstances.

6. Encourage employees to reduce electrical loads in their homes, to reduce demand on the utility system. If no one is at home during the workday, unneeded appliances and lights should be turned off, and air-conditioning thermostats should be set higher before departing for the day. Also, some utilities offer cost incentives to residential customers who allow the utility to remotely cycle off power to air-conditioning and electric water heating systems. Periods without power are limited, so that comfort is not sacrificed. Encourage employees to participate in these programs, to assist the local utility, while reducing their electricity bill.

7. Enhance employee awareness of energy efficiency through training and less formal methods. Provide mandatory and voluntary training opportunities on smart energy practices so that employees can practice energy efficiency during emergency periods and year-round. In addition to training, run public service announcements about energy efficiency on televisions in cafeterias and other public use areas; send periodic e-mail messages about turning off lights and computers and implementing other efficiency practices; post signs or billboards near light switches or communal printers; and consider holding annual energy fairs prior to seasonal emergency periods to provide additional information for employees about how to manage energy use in the work place and in their homes.

Lighting Measures

1. Turn off fluorescent lights when leaving an area for more than 1 minute. (During nonemergencies, 5 minutes is recommended, to keep from excessively reducing lamp life). Turn off incandescent lights when leaving areas for any period of time.

2. In areas with sufficient daylighting, turn off lights. Adjust blinds, if available, to reduce glare.

3. Use task lighting and turn off general lighting, where it is feasible to maintain sufficient lighting levels for safety and productivity.

4. Turn off display and decorative lighting.

5. Reduce parking lot and other exterior lighting consistent with safety and security requirements.

Personal Computers And Appliance Measures

6. Turn off printers when not in use.

7. Turn off monitors when not in use.

8. Ensure ENERGY STARÂ® power down features are activated.

9. If computers do not have ENERGY STARÂ® features available, turn them off when leaving the office for more than 30 minutes.

10. Ensure personal appliances, such as coffee pots and radios are turned off.

Heating and Air-Conditioning Measures

11. Reduce building operating schedules to limit operation of heating and cooling systems during noncore hours (e.g., nights and weekends).

12. Widen "no conditioning" temperature bands for both heating and cooling.

13. Precool building(s) below normal temperature settings prior to onset of peak demand period. Make sure to tell employees about this practice, so that they will not operate space heaters. During peak demand period, allow space temperatures to drift back up to normal settings (or as much as 5^{o}F above normal settings).

14. Allow casual attire, to make higher temperatures more acceptable.

15. Where systems allow, lower chilled water temperatures several degrees below normal settings prior to peak periods, and allow to drift above normal settings during peak periods.

16. Duty cycle air handling units off. Ensure adequate outside air flow rates to maintain indoor air quality.

17. Ensure that ventilation grilles and fan coil units are not blocked by books, flowers, debris, or other obstructions. This will improve air-conditioning system efficiency and improve comfort.

Other

18. Operate emergency generators (many agencies have negotiated financial incentives from their local utility for operating generators). Ensure that generators have ample fuel for emergency operation and have been tested routinely. Turn off shore power to ships in dock and operate ship power systems. Make mobile utility system electrical generating equipment available to the local utility.

19. Shut off selected elevators and escalators. Ensure accessibility needs are met.

20. Where feasible, schedule high electrical energy use processes during off peak periods.

21. Encourage employees to not use copiers during peak demand period. Turn off selected copiers. Ensure power saver switch on copiers is enabled.

22. Turn off unnecessary loads such as fountain pumps.

Long Term Solutions

23. Consider purchasing interruptible power for selected loads with high electrical demand, and which will not suffer adverse consequences in the event of the utility turning off power. The cost savings from the lower rate may far outweigh the inconvenience of power being turned off within the interruption limitations agreed to in the utility contract.

24. Consider installing submetering to identify high intensity loads to be shed during emergencies.

25. Investigate thermal storage systems or alternative energy sources for air-conditioning.

26. Install motion sensors and separate lighting circuits to allow turning off unneeded lights. (Some agencies have installed switching to separate public areas from agency work spaces).

27. Install an EMCS to allow shedding and monitoring loads from one central location. If noncritical loads are not separately switchable, modify systems to allow terminating. Local utilities or ESCO's can assist with this effort.

28. Consider adding onsite generation using micro-turbines, fuel cells, combined heat and power, renewable, or other ppropriate technology.

Appendix E

RESERVED

Appendix F

RESERVED

Appendix G

RESERVED

Appendix H: Federal Life-Cycle Costing Procedures and Supporting Software

H.1 Federal agencies are required to evaluate energy-related investments on the basis of minimum life-cycle costs (10 CFR Part 436). A life-cycle cost evaluation computes the total long-run costs of a number of potential actions, and selects the action that minimizes the long-run costs. When considering retrofits, sticking with the existing equipment is one potential action, often called the baseline condition. The life-cycle cost (LCC) of a potential investment is the present value of all of the costs associated with the investment overtime.

H.2 The first step in calculating the LCC is the identification of the costs. Installed Cost includes cost of materials purchased and the labor required to install them (for example, the price of an energy-efficient lighting fixture, plus cost of labor to install it). Energy Cost includes annual expenditures on energy to operate equipment. (For example, a lighting fixture that draws 100 watts and operates 2,000 hours annually requires 200,000 watt-hours (200 kWh) annually. At an electricity price of $0.10 per kWh, this fixture has an annual energy cost of $20.) Nonfuel O&M includes annual expenditures on parts and activities required to operate equipment (for example, replacing burned out light bulbs). Replacement Costs include expenditures to replace equipment upon failure (for example, replacing an oil furnace when it is no longer usable).

H.3 Because LCC includes the cost of money, periodic and a periodic maintenance (O&M) and equipment replacement costs, energy escalation rates, and salvage value, it is usually expressed as a present value, which is evaluated by

$$LCC = PV(IC) + PV(EC) + PV(OM) + PV(REP)$$

where	PV(x) denotes "present value of cost steam x," IC is the installed cost, EC is the annual energy cost, OM is the annual nonenergy O&M cost, and REP is the future replacement cost.

H.4 Net present value (NPV) is the difference between the LCCs of two investment alternatives, e.g., the LCC of an energy-saving or energy cost-reducing alternative and the LCC of the existing, or baseline, equipment. If the alternative's LCC is less than the baseline's LCC, the alternative is said to have a positive NPV, i.e., it is cost-effective. NPV is thus given by

$$NPV = PV(EC0) - PV(EC1)) + PV(OM0) - PV(OM1)) + PV(REP0) - PV(REP1)) - PV(IC) \text{ or } NPV = PV(ECS) + PV(OMS) + PV(REPS) - PV(IC)$$

where	subscript 0 denotes the existing or baseline condition, subscript 1 denotes the energy cost saving measure, IC is the installation cost of the alternative (note that the IC of the baseline is assumed zero), ECS is the annual energy cost savings, OMS is the annual nonenergy O&M savings, and REPS is the future replacement savings.

H.5 Levelized energy cost (LEC) is the breakeven energy price (blended) at which a conservation, efficiency, renewable, or fuel-switching measure becomes cost-effective (NPV>= 0). Thus, a project's LEC is given by

$$LEC = (PV(OMS) + PV(REPS) - PV(IC))/EUS$$

where	EUS is the annual energy use savings (energy units/yr). Savings-to-investment ratio (SIR) is the total (PV) savings of a measure divided by its installation cost:

$$SIR = (PV(ECS) + PV(OMS) + PV(REPS))/PV(IC).$$

H.6 Some of the tedious effort of life-cycle cost calculations can be avoided by using the Building Life-Cycle Cost software, BLCC, developed by NIST. For copies of BLCC, call the FEMP Help Desk at (800) 566-2877.

H.7 Centers can obtain the ECONPACK for Windows software from a CD-ROM program distributed through the National Institute of Building Sciences (NIBS), Construction Criteria Base (CCB), and available through the Center's NASA SPECSINTACT construction specifications manager. The software can be used for 30 days if arrangements are made to "unlock" the software by contacting the developer at the following address:

U.S. Army Corps of Engineers
Engineering and Support Center, Huntsville (ECONPACK)
P.O. Box 1600
Huntsville, AL 35807-4301
Telephone No.: (256) 895-1838

Centers can also obtain additional information on the ECONPACK Program and download the latest version of the software from the U.S. Army Corps of Engineers Military Program (CEMP) Web site at: http://www.hq.usace.army.mil/cemp/e/ec/econ/econ.htm

Appendix I

RESERVED

Appendix J

RESERVED

APPENDIX K. Resources for Lighting and Waste Disposal Information

K.1 Lighting and Waste Disposal Resources

K.1.1 EPA Regional Offices

a. Region III (PA, WV, VA, MD, DE, DC)
Environmental Protection Agency
841 Chestnut Building
Philadelphia, PA 19107
(215) 597-9800

b. Region IV (TN, KY, NC, SC, GA, AL, MS, FL)
Environmental Protection Agency
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-4727

c. Region V (IL, WI, IN, MI, MN, OH)
Environmental Protection Agency
77 West Jackson Boulevard
Chicago, IL 60604-3507
(312) 353-2000

d. Region VI (NM, TX, OK, AR, LA)
Environmental Protection Agency
First Interstate Bank Tower at Fountain Place
12th Floor, Suite 1200
1445 Ross Avenue
Dallas, TX 75202-2733
(214) 665-6444

e. Region IX (CA, NV, AZ, HI, American Samoa, Guam)
Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105
(415) 744-1305

K.1.2 EPA Lighting Upgrade Manual

a. U.S. Environmental Protection Agency
Office of Air and Radiation 6202J
EPA 430-B-95-003, January 1995
http://www.epa.gov/oar/

K.1.3 State Solid and Hazardous Waste Agencies

a. Alabama: Department of Environmental Management
Land Division (Solid/Hazardous Waste)
1751 Federal Drive
Montgomery, AL 36130
(205) 271-7761/7735

b. California: Department of Toxic Substances Control
P.O. Box 806
Sacramento, CA 95812-0806
(916) 322-0712

c. District of Columbia: Department of Consumer and Regulatory Affairs
Environmental Regulation Administration
Pesticides, Hazardous Waste, and Underground Storage Tank Division
Hazardous Waste Management Branch
2100 Martin Luther King Jr. Avenue, SE, Suite 203
Washington, DC 20020
(202) 404-1167

d. District of Columbia: Department of Public Works
Public Space Maintenance Administration
Bureau of Sanitation Services (Solid Waste Disposal/Recycling)
2750 South Capitol Street, SE
Washington, DC
(202) 767-8512

e. Florida: Bureau of Solid and Hazardous Waste
Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904) 488-0300

f. Louisiana: Department of Environmental Quality
Office of Solid and Hazardous Waste
Solid Waste Division
P.O. Box 44307
Baton Rouge, LA 70804
(504) 765-0355

g. Maryland: Department of Environment
Toxic Operations Program
2500 Boening Highway
Baltimore, MD 21224
(410) 631-3345

h. Mississippi: Department of Environmental Quality
Office of Pollution Control
P.O. Box 10358
Jackson, MS 39209
(601) 961-5171

i. New Mexico: New Mexico Environmental Department
Harold Runnels Building
P.O. Box 26110
Santa Fe, NM 87502
Hazardous and Radioactive Materials Bureau: (505) 827-4308
Solid Waste Bureau: (505) 827-2775

j. Ohio: Environmental Protection Agency
Office of Solid and Hazardous Waste
P.O. Box 1049
1800 Watermark Drive
Columbus, OH 43266-0149

k. Texas: Texas Water Commission
P.O. Box 13087
1700 North Congress Avenue
Austin, TX 78711-3087

(512) 463-7830

l. Virginia: Virginia Department of Environmental Quality
Special Solid Waste Program
P.O. Box 10009
Richmond, VA 22240
(804) 527-5357

K.1.4 National Hotlines

a. Toxic Substances Control Act (TSCA) Assistance Information Hotline: (202) 554-1404

b. RCRA/CERCLA Hotline: (800) 424-9346; in the Washington, DC metro area: (703) 412-9810

c. CERCLA National Response Center (NRC) Hotline: (800) 424-8802

Appendix L

RESERVED

Appendix M

RESERVED

Appendix N

RESERVED

Appendix O

RESERVED

Appendix P

RESERVED

Appendix Q

RESERVED

Appendix R

RESERVED

Appendix S

RESERVED

Appendix T

RESERVED

Appendix U

RESERVED

APPENDIX V. DOE Guidance on Facility Water Management Plans and Water Efficiency Improvement Best Management Practices (BMP)

Recommended Elements of a Facility Water Management Plan

1) Operation and Maintenance (O&M) recommendations. Include appropriate O&M recommendations from the FEMP Best Management Practices in facility operating plans or procedure manuals.

2) Utility Information, including:

a) Contact information for all water and wastewater utilities.

b) Current rate schedules and alternative schedules appropriate for your usage or facility type. You want to be sure you are paying the best rate.

c) Copies of water/sewer bills for the past 2 years. This will help you identify inaccuracies and determine that you are using the appropriate rate structure.

d) Information on financial or technical assistance available from the utilities to help with facility water planning and implementing water efficiency programs. Sometimes energy utilities offer assistance on water efficiency.

e) Contact information for the office that pays the water/sewer bills.

f) Production information, if the facility produces its water and/or treats its own wastewater.

3) Facility information. At a minimum, perform a walk-through audit of the facilities to identify all major water using processes; location and accuracy of water measurement devices; main shut off-valves; verify operating schedules and occupancy of buildings. Because of reporting requirements in Executive Order13123, facilities should include a description of actions necessary to improve the accuracy of their water usage data. This can include a metering (or other measurement) plan for the facility.

4) Emergency response information. Develop water emergency and/or drought contingency plans that will describe how your facility will meet minimum water needs in an emergency or reduce water consumption in a drought or other water shortage. This should be done in conjunction with your local water supplier.

5) Comprehensive Planning. Inform staff contractors and the public of the priority your agency or facility places on water and energy efficiency. Ensure that they take water supply, wastewater, storm water issues and water efficiency BMPs into account at the earliest stages of planning and design for renovation and new construction.

BMP # 1 - Public Information and Education Programs Background

Educating users is very important if water conservation technologies and methods are to be successful. Experience shows that it is not enough to install a retrofit or water saving technology in a facility. New operation procedures, retrofit or replacements are most effective when employees, contractors and the public know what the new technology or methods are and how to use them properly.

An additional benefit to water conservation is positive public opinion. If your facility is doing its part to save the community resources, let them know. Informing the public about your facilities commitment to reduce waste is good news. The news media is often interested in facilities that take a proactive stand on water conservation.

Internal Options

Establish a user-friendly hot line or other systems to report leaks or other wastes of water and energy. Repair promptly to encourage continued participation.

Keep employees informed about your commitment to water conservation, your ongoing conservation program and any program successes. Start a water column in your building or agency newsletter featuring how much water has been saved through the water management program. Send information via e-mail.

Place sign and placards near new equipment so it is easy understand the new technology and how to use it properly.

Start a suggestion and incentive system to recognize and encourage water saving in you facility. Consider distributing efficiency devices.

Conduct regular training workshops for maintenance personnel to keep them up to date on operational changes and maintenance procedures.

External Options Work with local utilities to develop comprehensive programs and share your successes with other similar facilities.

Invite members of the local news media to tour you facility and see first-hand the conservation program and successes you have achieved.

Create displays presenting your water conservation results for posting in your lobby and other public reception areas.

Develop Web sites, brochures and other materials for distribution to employees and the public describing your program, goals and successes.

BMP # 2 - Distribution System Audits, Leak Detection and Repair Background

A distribution system audit, leak detection and repair program can help facilities reduce water losses and make better use of limited water resources. If you are located at the average, circa 1940's, military facility it is very likely that much more than 10 percent of your total water production and purchases are lost to system leaks. Regular surveys of distribution systems should always be conducted prior to obtaining additional supplies and can have substantial benefits including:

Reduced water losses. Reducing water losses will help stretch the existing supplies to meet increasing demand. This could help defer the construction of new water facilities such as wells, reservoirs, or treatment plants.

Reduced operating costs. Repairing leaks will save money by reducing power costs to deliver water, and reduce chemical to treat water.

Increased knowledge of the distribution system. As personnel become more familiar with the system including knowing the location of mains and valves, they are able to respond more quickly to emergencies such as main breaks.

Reduce property damage. Repairing system leaks can prevent damage to property and safeguards public health and safety.

Operations and Maintenance

Complete a prescreening system audit to determine the need for a full-scale system audit using one of the following methods. Every two years:

1. Determine authorized uses

2. Determine other system verifiable uses

3. Determine total supply into the system

Divide authorized uses plus other verifiable uses by total supply into the system. If this quantity is less than 0.9, a full-scale system audit and leak detection program is indicated. Or

Once a system audit has been conducted, obtain and monitor minimum system flow. This is usually the flow rate at around 3 or 4 AM. Significant increases to this amount can be assumed to be leak-related and would indicate that a full-scale leak detection survey is necessary.

When indicated, facilities shall complete full-scale water audits of their distribution systems using a methodology consistent with that described in the American Water Works Association's "Water Audit and Leak Detection Guidebook, Number M36."

Retrofit and Replacement Options Repair leaks or replace pipes when leaks are found.

For specifics on this technology, consult with experts in the field. Your first resource should be your local or higher headquarters engineers, but do not overlook or rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOD, CERL, DOE, and FEMP).

BMP # 3 - Water Efficient Landscaping Background

In most locations, traditional landscapes require supplemental water to thrive. For example, Kentucky bluegrass is native to regions that receive in excess of 40 inches per year of precipitation. To make up the difference between a plant's water requirement and the natural precipitation in your area, additional water must usually be added in the form of irrigation.

If your facility includes any irrigated landscape, then exterior water use should be an important part of your overall water conservation program. There are a number of good reasons to have a water efficient landscape:

Native and other "climate appropriate" landscape materials can reduce irrigation water use by more than 50 percent.

Reduced turf and other irrigated areas can significantly reduce time and money spent mowing, fertilizing, removing green wastes and maintaining landscapes.

Over-watering can cause more damage to plant materials than under-watering and can damage streets, curbs, other paving and building foundations.

Operation and Maintenance Options Periodically review all landscape service and maintenance agreements to incorporate high priority for water, chemicals and energy conservation. Consider incorporating a performance standard for water use and other parameters into contracts. Encourage landscape contractors to report and fix problems.

Consider installing an irrigation meter to measure the amount of water applied to the landscape. Some water utilities offer an interruptible rate for the service or will provide a credit to the sewer charges.

Verify that irrigation schedule is appropriate for climate, soil conditions, plant materials, grading, and season. Water only in the early morning to minimize evaporation. This will maximize the effectiveness of watering while minimizing the amount of water used and the opportunity for fungus growth. Generally, it is better to water deeply less frequently than to water lightly often.

Recirculate water in decorative fountains, ponds and waterfalls and shut off when possible to reduce evaporation losses. Check water recirculation systems annually for leaks and other damage. Consider using nonpotable water in these systems.

Monitor irrigation systems for effectiveness. Make sure sprinkler heads are placed and adjusted so that they will water the landscape, not the pavement. Water plant roots, not trunks or leaves. Check for dirty or broken emitters. Verify that irrigation system pressure is within manufacturer specifications. Make sure replacement emitters match existing equipment.

Alternate your turf mowing height between low and high levels. This encourages roots to grow deeply and helps make plants more able to go longer between watering. Keep the irrigated landscape weed free so that valuable water is consumed only by decorative landscape. Mulch also helps reduce weed growth.

Make sure all handheld hoses have shut-off nozzles.

Establish user-friendly method to report irrigation system problems and fix them immediately.

Retrofit Options Install an irrigation timer to appropriately schedule sprinkler use. Verify that emitters are appropriate to the plants being irrigated. Use low flow sprinkler heads instead of turf sprinklers in areas with plants, trees or shrubs.

Use a soil tensiometer or other sensor to determine when the soil is dry and gauge the amount of water needed. If using a variety of automatic controls, make sure they have a manual override feature and that you use it. This way, if it rains, you can cancel your next watering. Rain sensors can also be installed to shut off automated irrigation systems when it is raining.

Select climate appropriate turf, trees, shrubs and ground cover.

Eliminate "strip grass" to the greatest extent possible. Small strips of grass, common in parking islands and between sidewalks and the roadway are hard to maintain and difficult to efficiently water, use bushes, mulch, colored tiles, instead.

Replacement Options Install irrigation systems that have controls or sensors

Use a trickle or subsurface irrigation system that is installed underground and provides water directly to the roots, preventing water loss from evaporation and run-off.

Use water from other systems such as once through cooling systems, cooling tower bleed off or other nonpotable sources such as reclaimed water, or gray water, where environmentally appropriate.

Replace or install entire landscape with climate appropriate, water-efficient materials and an efficient irrigation system.

BMP # 4 - Toilets and Urinals Background

The United States uses about 4.8 billion gallons of water every day to flush waste. Since toilets and urinals account for nearly one third of building water consumption, the potential for savings in this area is significant. Unless your facility is relatively new or has been refurbished recently, chances are that your toilets and urinals are consuming too much water. Current Federal law requires that residential toilets manufactured after January 1, 1994 must use no more than 1.6 gallons per flush (gpf). Commercial toilets manufactured after January 1, 1997 must use no more than 1.6 gpf and urinals must use no more than 1 gpf.

Ultra-low flush fixtures have been the topic of a great deal of discussion. When first introduced these fixtures were often judged to be inadequate. Unfortunately, the poor performance of early models continues to cast a cloud of doubt over the technology. However, ultra-low flush toilets have come a long way. For instance, early modifications to flush valves to reduce the volume of water, without changing the bowls, led to many reports of clogging and double flushing. As a result, national standards have been established to match tanks and bowls, and accommodate varying water pressure. Most surveys conducted to measure consumer satisfaction with ultra-low flush toilets have shown an acceptance or satisfaction rate of more than 80 percent.

Operation and Maintenance Options

Establish user-friendly method to report leaks and fix them immediately.

When performing maintenance replace worn parts and adjust mechanisms to ensure that the water consumed per flush meets manufacturers' guidance.

Encourage cleaning or custodial crews to report problems.

Retrofit Options Retrofits for tank style toilets, such as displacement dams or bags may hamper overall operation of the toilet and increase maintenance costs, as they often have a short life span and require frequent replacement or adjustment. Therefore, they may not be appropriate for many Federal facilities.

For flush valve style toilets, infrared or ultrasonic sensors can be used to automatically activate flushing, making it unwieldy for users to flush twice. However, these devices need to be set properly to avoid multiple flushing.

Also early closure or valve insert or replacement devices can reduce flush volumes from 0.6 to 2 gpf. However, they often require frequent replacement or adjustment. Therefore, they may not be appropriate for many Federal facilities.

Replacement Options Replace 3.5 to 7 gpf toilets, to maximize water savings, with valves and porcelain specifically designed to use 1.6 gpf. Site specific evaluation of existing waste lines, water pressure, distance, usage, settling, and types of users (e.g., employees, residents, occasional members of the public, and high visitor populations) is necessary to determine the appropriate models for a specific site. Where appropriate, recycle used parts (crushed vitreous china can be used for roadbed materials), to minimize land fill impacts.

Replace urinals with models designed to use 1 gpf or install a waterless (no-flush) urinal.

In remote areas, consider replacing water using toilets and urinals with alternative technologies such as composting or incinerator toilets.

Consider nonpotable water for toilet and urinal flushing.

For specifics on this technology, consult with experts in the field. Your first resource should be your local or higher headquarters engineers, but do not overlook or rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOE and FEMP).

BMP #5- Faucets and Showerheads Background

Tremendous amounts of water and energy are wasted using water-inefficient faucets and showerheads. Federal guidelines mandate that all lavatory and kitchen faucets and aerators manufactured after January 1, 1994, must use no more than 2.2 gpm, showerheads must use no more than 2.5 gpm. If your facility still uses older faucets and showerheads, there is a significant opportunity to save both water and energy costs.

Operation and Maintenance Options

Establish user-friendly method to report leaks and fix them immediately. Encourage cleaning or custodial crews to report problems.

Test system pressure to make sure it is between 20 and 80 psi. If the pressure is to low, then low consuming devices won't work properly, if its too high they will consume more than their rated amount of water.

Install expansion tanks, pressure reducing valves and reduce water heater settings, where appropriate, to prevent temperature and pressure relief valves from discharging water.

Correctly adjust and maintain automatic sensors to ensure proper operation.

Encourage users to take shorter showers.

Post energy/water awareness information to encourage conservation from users.

Retrofit/Replacement Options Install showerheads that achieve the 2.5 gpm and aerator or laminar flow devices that achieve the 2.2 gpm requirement.

Install temporary shut-off valves in faucets. These valves cut off the water flow during intermittent activities like scrubbing or dishwashing. The water can be reactivated at the previous temperature without the need to remix the hot and cold water.

Install automatic shut-off valves. These can be operated by infrared or ultrasonic sensors, which detect the presence of someone's hands and will shut off water when the hands are removed. However, these devices need to be set properly to operate properly.

BMP # 6 - Boiler/Steam Systems Background

Boiler and steam generators are commonly used in large heating systems, institutional kitchens or in facilities where large amounts of process steam are used. This equipment consumes varying amounts of water depending on the size of the system, the amount of steam used and the amount of condensate return.

Operation and Maintenance Options

Develop and implement a routine inspection and maintenance program on steam traps and steam lines.

Maintain proper water treatment to prevent system corrosion and optimize cycles of concentration.

Develop and implement routine inspection and maintenance program on condensate pumps.

Use periodic quality assurance of boiler water treatment.

Regularly clean and inspect boiler water and fire tubes. Reducing scale buildup will reduce the amount of blowdown necessary as well as improve the energy efficiency of the system.

Retrofit Options Install and maintain condensate return system. By recycling condensate for reuse, water supply, chemical use and operating costs for this equipment can be reduced by up to 70 percent. A condensate return system also helps lower energy costs as the condensate water is already hot and need less heating to produce steam than water from other make-up sources.

Install an automatic blowdown system based on boiler water quality to better manage the treatment of boiler make-up water.

Add an automatic chemical feed system controlled by makeup water flow.

Replacement Options Replacement options vary depending on the size of the facility and existing equipment. Consider performing an energy audit to reduce heating load and ensure that the system is sized appropriately. Reducing the size of the boiler system can reduce water requirements.

Always purchase the most life cycle cost-effective boiler available for new installations or major renovations.

Consider installing a small summer boiler, small distributed system or heat capture system for reheat or dehumidification requirements instead of running a large boiler at part load. Also consider alternative technologies such as heat pumps.

For specifics on this technology, consult with experts in the field. Your first resource should be your local or higher headquarters engineers, but do not overlook or rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOE and FEMP).

BMP # 7 - Single-Pass Cooling Equipment Background

Single-pass or once through cooling systems provide an opportunity for significant water savings. In these systems, water is circulated once through a piece of equipment and then disposed down the drain. To remove the same heat load, single-pass systems use 40 times more water than a cooling tower operated at 5 cycles of concentration. The types of equipment that typically use single-pass cooling are: CAT scanners, degreasers, hydraulic equipment, condensers, air compressors, welding machines, vacuum pumps, ice machines, x-ray equipment and air conditioners.

Operation and Maintenance Options

Provide proper insulation on piping, chiller or storage tank.

Inventory cooling equipment and identify all single-pass cooling systems.

Check entering and leaving water temperatures and flow rates to ensure that they are within the manufacturer's recommendations. For maximum water savings, water flow rate should be near the minimum allowed by the manufacturer.

Keep coil loops clean to maximize heat exchange with the refrigerated enclosure.

Retrofit Options Add an automatic control to shut off entire system during unoccupied night or weekend hours. This option should only be considered where shutdown would have no adverse impact on indoor air quality.

Modify equipment to operate on a closed loop that recirculates the water instead of discharging it.

Find another use for the single pass effluent, in boiler make-up supply or landscape irrigation and implement. Note some equipment effluent may be contaminated such as degreasers, hydraulic equipment. This effluent should not be used in boilers.

Replacement Options Replace the once through cooling systems with a multipass cooling tower or closed loop system.

Replace water-cooled equipment with air-cooled equipment or best available energy /water efficient technology.

For specifics on this technology, consult with experts in the field. Your first resource should be your local or higher headquarters engineers, but do not overlook or rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOE and FEMP).

BMP # 8 Cooling Tower Management Background

Cooling towers help regulate temperature by rejecting heat from air-conditioning systems or by cooling hot equipment. In doing so, they use significant amounts of water. The thermal efficiency, proper operation and longevity of the water cooling system all depend on the quality of water and its reuse potential.

In a cooling tower, water is lost through evaporation, bleed-off, and drift. To replace the lost water and maintain its cooling function, more make-up water must be added to the tower system. Sometimes water used for other equipment within a facility can be recycled and reused for cooling tower make-up with little or no pretreatment, including the following:

Water used in a once through cooling system

Pretreated effluent from other processes, provided that any chemicals used are compatible with the cooling tower system.

High-quality municipal wastewater effluent or recycled water (where available)

Operation & Maintenance Options Consider measuring the amount of water lost to evaporation. Some water utilities will provide a credit to the sewer charges for evaporative losses.

Find out if conductivity is actually representative of your controlling parameter. Depending on your water supply, the equipment being cooled and the temperature differential across the tower, your parameter may be hardness, silica, total dissolved solids, algae or others. Once you determine the relationship between conductivity and your controlling parameter, set you blowdown valve to keep that parameter constant.

Install conductivity and flow meters on make-up and bleed-off lines. Meters that display total water being used as well as current rate of flow are most useful. Check the ratio of conductivity of make-up water and the bleed off conductivity. Then check the ratio of bleed-off flow to make up flow. If both ratios are not about the same, check the tower for leaks or other unauthorized draw-off. Read conductivity and flow meters regularly to quickly identify problems. Keep a log of make-up, bleed-off consumption, dissolved solid concentration, evaporation, cooling load, and concentration ratio.

Consider using acid treatment such as sulfuric or ascorbic acid, where appropriate. When added to recirculating water, acid can improve the efficiency of the water by controlling scale buildup created from mineral deposits. Acid treatment lowers the pH of the water, and is effective in converting a portion of the calcium bicarbonate, the primary cause of scale, into the more readily soluble forms. Make sure that workers are fully trained in the proper handling of acids. Also note that acid overdoses can severely damage a cooling system, so use a timer and add acid at points where the flow of water is well mixed and reasonably rapid. Also beware that lowering pH may mean you may have to add a corrosion inhibitor.

Select your chemical treatment vendor with care. Tell vendors that water conservation is a high priority and ask them to estimate the quantities and costs of treatment chemicals, volumes of bleed-off water and the expected concentration ratio. Keep in mind that some vendors may be reluctant to improve water efficiency because it means the facility will purchase fewer chemicals. In some cases, saving on chemicals can outweigh the savings on water costs. Vendors should be selected based on "cost to treat 1000 gallons makeup water" and highest "recommended system water cycle of concentration."

Retrofit Options Install a sidestream filtration system that is composed of a rapid sand filter or high-efficiency cartridge filter to cleanse the water. These systems draw water from the sump, filter out sediment and return the filtered water to the tower, enabling the system to operate more efficiently with less water and chemicals. Sidestream filtration is particularly helpful if your system is subject to dusty atmospheric conditions. Sidestream filtration can turn a troublesome system into a more trouble-free system.

Install covers to block sunlight penetration. Reducing the amount of sunlight on tower surfaces can significantly reduce biological growth such as algae.

Consider alternative water treatment options such as ozonation or ionization, to reduce water and chemical usage. Be careful to consider life cycle cost impact of such systems.

Install automated chemical feed systems on large cooling tower systems (over 100 ton). The automated feed system should control blowdown/bleed-off by conductivity and then add chemicals based on makeup water flow. These systems minimize water and chemical use while optimizing control against scale, corrosion and biological growth.

Replacement Options Get expert advice to help determine if a cooling tower replacement is appropriate. New cooling tower designs and improved materials can significantly reduce the water and energy requirements for cooling. However, since replacing a cooling tower involves significant capital costs, the facility manger should investigate every retrofit and O&M option available and compare their costs and benefits to a new tower. For specifics on this technology, consult with experts in the field. Your first resource should be your local or higher headquarters engineers, but do not overlook or rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOE and FEMP).

BMP # 9 - Miscellaneous High Water-Using Processes Background

Many other high water using processes are found at federal facilities, including kitchens and food processing, cleaning/laundry services, laboratories, fish hatcheries and other environmental uses, Treasury production, and so on. High water using processes should be identified and analyzed for potential water and energy efficiency improvements.

Operation and Maintenance, Retrofit, and Replacement Options

Consider metering or otherwise measuring the amount of water used in high watering processes.

Get expert advice to help determine if water efficiency improvements are appropriate. New system designs and improved materials can significantly reduce the water and energy requirements. However, since this may involve significant capital costs, the facility manger should investigate every retrofit or O&M option first. Your first resource should be your local or higher headquarters engineers, but do not overlook or rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOE and FEMP). New Facilities Construction and Major Renovations Efficient water use should be considered and implemented where appropriate in the design and construction of all new federal facilities.

BMP # 10 - Water Reuse and Recycling Background

Many facilities may have water uses that can be met with nonpotable water. Due to unclear terminology, several entirely different water reuse concepts are often confused. Some of these concepts and appropriate uses include:

Filtered but otherwise untreated water, which can often be easily reused onsite for nonpotable uses without being discharged to the wastewater system. Examples include using rinse water from laundries or car washes for the next wash process, or cooling tower condensate distributed for adjacent landscape irrigation.

Wastewater that is treated to meet high standards at a wastewater treatment plant can then be redistributed for nonpotable uses. Pursuant to health regulations established under the Clean Water Act and various States' regulations, this water is allowed for nonpotable uses, including landscape irrigation, decorative water facilities, cooling towers and other industrial processes, fire sprinkler systems, and as flush water for toilets and urinals. Although treatment and distribution of this water can be expensive, it is usually cost-effective when compared to the costs to develop additional potable water supplies.

Water from showers/baths and clothes washers (not used to wash diapers or process food), which can be used for landscape irrigation. Use of this water at Federal facilities is generally not recommended because of high capital costs and health and safety issues.

Operation and Maintenance, Retrofit, and Replacement Options As described in other BMPs, potential nonpotable water use should be identified while reviewing current water use practices. The use of nonpotable water is generally most cost-effective when included in the design of new facilities. For specifics, consult with experts in the field. Your first resource should be your local or higher headquarters engineers, but do not rule out the benefits of input from experienced contractors or other Governmental agencies (e.g., DOE and FEMP).

Water Management References

Water Management: A Comprehensive Approach for Facility Managers, General Services Administration, http://www.gsa.gov/Portal/browse/channel.jsp?channelId=-13867&channelPage=/channel/default.jsp&cid=1

Military Handbook 1165: Water Conservation, Naval Facilities Engineering Service Center; http://www.afcesa.af.mil/Directorate/ces/Civil/Water/Water.htm or http://energy.navy.mil/key-areas/WaterWeb.html

Roadside Use of Native Plants; Federal Highway Administration; http://www.fhwa.dot.gov/environment/veg_mgt.htm or environment@fhwa.dot.gov

A Water Conservation Guide for Commercial, Institutional and Industrial Users, New Mexico Office of the State Engineer; (800)WATER-NM

Appendix W

RESERVED

Appendix X

RESERVED

Appendix Y

RESERVED